

CHAPTER 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This Chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter.

Physical Environment

Hydrology and Soils

Affected Environment:

Geology

The three main geological units underlying the project area are Tertiary undifferentiated intrusive rocks, the Madison (Pahasapa) Limestone and Englewood Formations, and the Minnelusa Formation.

The Tertiary igneous rocks are found in the southwest portion of the project area. The upper third of the Madison/Englewood is dominated by karst topography. The karst topography consists of large solution or collapse structures, which act as conduits for transporting surface runoff and snowmelt into the groundwater system (Williams, MIS report, 2002, pg. 98). These features have resulted in extensive secondary permeability and have created potentially the most productive aquifer in the Black Hills.

The Whitewood Dolomite, Minnelusa Formation, and the White River Group are the other dominant sedimentary units within the project. The Minnelusa is also another major aquifer, due to the presence of solution collapse structures forming secondary permeability (Stroebe et al. 1999).

Climate and Watersheds

The Black Hills, located near the continent's center, has a near perfect semi-arid continental climate, modified by the influences of a mountain climate. Winters are comparatively cold and summers warm (FEIS, 1996, pg. Preface-11). April, May and June have the highest mean precipitation with 3.07, 4.09 and 4.01 inches per month, respectively. The maximum mean temperatures are in July and August at 86.0 and 86.9° F. The coldest month is January with a mean minimum temperature of 12.8 °F. Research indicates that 6-27% of the precipitation is available for stream flow and groundwater recharge is primarily through snowmelt. Water yields are greatest in April, May and June from rain events. Typically precipitation in the northern Black Hills is enough to sustain

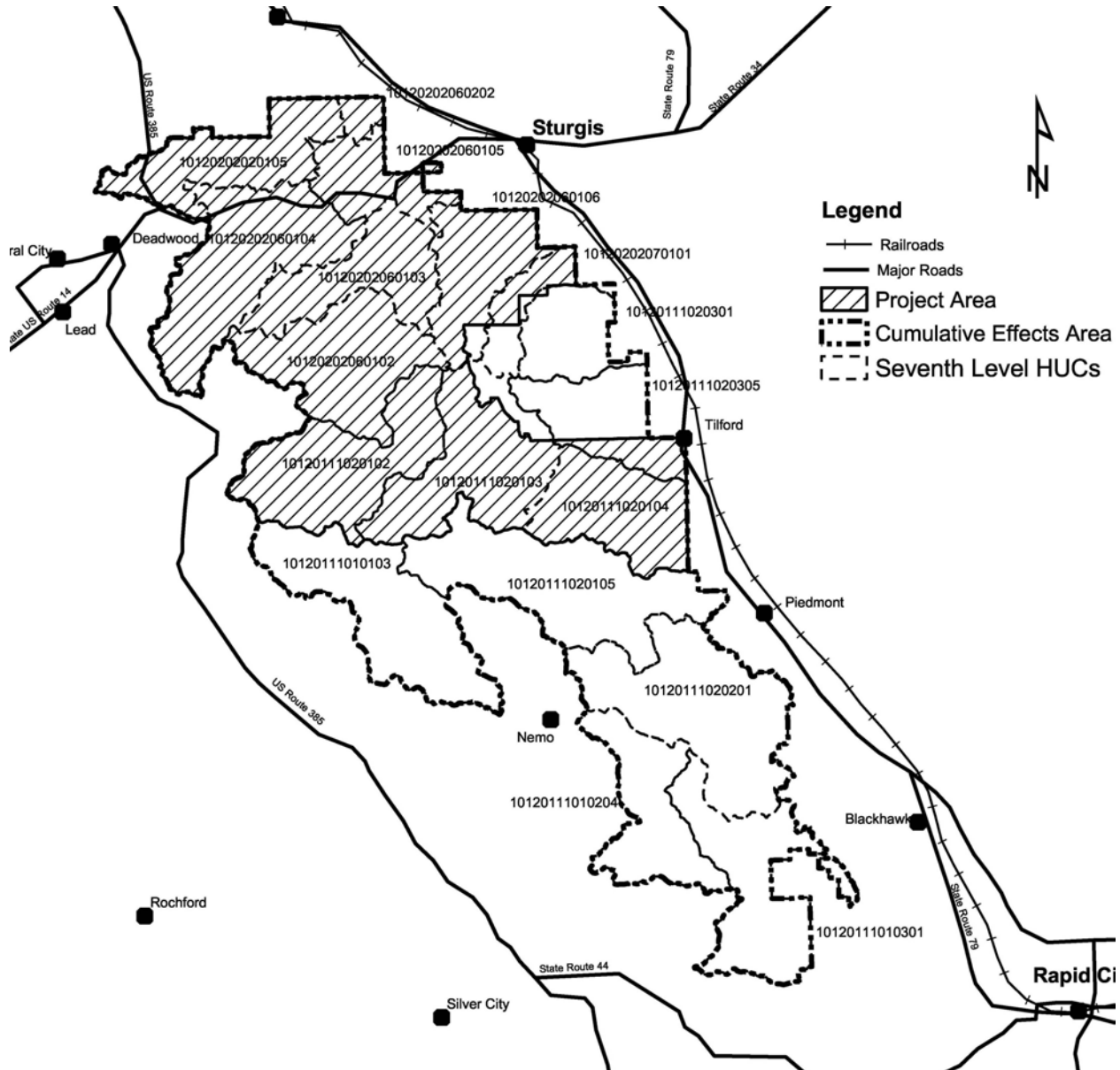
perennial flow in areas where the underlying geology will maintain surface flow (FEIS, 1996, pg. III-39-41).

Watersheds are defined as an area of land that drains water, sediment and dissolved materials into a common outlet. The U.S. Geological Survey has devised hydrologic unit codes (HUC) that divide the lower contiguous states into regions and assigns numbers to them. These regions are in turn divided into smaller and smaller units, with each unit having their own number or field (Nelson 2002). For data analysis purposes, the 7th field sub-watersheds were selected. The Elk Bugs and Fuels project includes thirteen 7th level sub-watersheds (See Figure 2). Eight of these watersheds are only partially within the project area, with less than 1% to 70% inclusion within the project area. Four watersheds are completely within the project area. Watershed 20103 has 88% of its area within the project boundary and was considered as entirely within the project area for analysis purposes. Table 29 summarizes this information under cumulative effects.

Elevations range from approximately 3600 feet to 5880 feet. Land-type Associations found within the project area include: Limestone Canyons, Crystalline Hills and Ridges, Moderately Rolling Uplands, North Gently Dipping and Steeply Dipping Plateau Lands, Valley Land, and Volcanic Hills and Ridges. The Limestone Canyon's association has narrow ridges, very steep side-slopes, narrow valley bottoms, and rock outcrops. Side-slopes are typically steeper than 40%. The limestone geology is key in controlling the location and type of streams, and local aquifers, in the Black Hills. Karst topography and solution and collapse structures characterize the Madison Limestone, Englewood, and Minnelusa Formations. These features act as conduits for transmitting surface runoff and snowmelt to groundwater systems.

The Moderately Rolling Uplands Association is characterized by broad ridges, moderately sloping to steep sideslopes, narrow to broad valley bottoms and rock outcrops. Sideslopes are predominantly 15-30 percent. Metamorphic rock typify outcrops. Gently Dipping Plateau Lands have broad and narrow ridges and valley bottoms. Some rock outcrops occur and sideslopes tend to be 15-30% compared to 30-50% for the Steeply Dipping Plateau Lands. Although this land type has broad ridges, valley bottoms are narrow. Rock outcrops are of sandstone, limestone and shale.

Figure 2 Hydrologic Unit Codes 7th level sub-watersheds



Valley lands have gentle sideslopes of 5-20%, broad ridges, and broad valley bottoms. Rock outcrops occur and consist of sandstone, shale, siltstone, and gypsum. Volcanic Hills and Ridge lands have steep to very steep sideslopes ranging from 30-45 percent. Valley bottoms are narrow and rock outcrops can occur. The Crystalline Hills and Ridges Association have narrow ridges and valley bottoms, and slopes ranging from 20-35% slopes. Rock outcrops are present (FEIS, 1996, Appendix K).

A watershed assessment summarizing conditions existing at the time of the development of the Forest Plan FEIS (1996) is located in Appendix J of the 1996 Revised Land Resource Management Plan. Figure III-3 of the FEIS displays the 5th and 6th level HUC's defined at that time. Appendix J (FEIS, 1996) summarizes existing watershed conditions by documenting the Natural Watershed Sensitivity Index, the Impact Index, and Watershed Class.

The Natural Watershed Sensitivity Index (NWSI) was determined by taking the sum of stream buffered areas, high erosion hazard soils, and slopes over 80%, divided by total watershed acreage. Sensitivity indices over 65 indicate that a watershed may be highly sensitive to impacts from management activities. The Impact Index is defined as the sum of management activities within the NWSI areas as modified by observations, divided by the total Natural Watershed Sensitivity acres. Impact Indices over 11 indicate the need for further analyses. Watershed Class compares the NWSI and the Impact Index. Class II watersheds are of moderate concern. Class III watersheds are of high concern and must be managed with care (Revised Forest Plan FEIS).

Since the completion of the FEIS and the Forest Plan, watershed boundaries have been revised. GIS analysis overlaid "old" and "new" watershed boundaries and determined which 7th level sub-watersheds were related to the 5th level watersheds defined in the FEIS. Analysis for this project is being conducted at the 7th level sub-watershed due to the project's large scale.

Table 11 documents the inter-relationship between the 1996 5th level watersheds and the 2003 7th level sub-watersheds.

Watersheds 90-01 (Alkali Creek), 89-01 (Box Elder Creek), and 87-02 (Bear Butte Creek) are rated as Class II watersheds. Watersheds 88-01, 02, 04 (Elk Creek), 87-01 (Bear Butte Creek) and 86-01 (Whitewood Creek) are rated as Class III watersheds. These indices and class designations for the 5th level watersheds serve as a general indicator of 7th level HUC or watershed conditions at the time the Forest Plan FEIS was completed. Similar analysis at the 7th level sub-watersheds is not available.

Since the completion of the Forest Plan FEIS and the 1997 Forest Plan, there have been no significant changes in the amount of mining or grazing within the project area (D. Murray, 2003, Personal communication.). Timber harvest activities have continued, including the Veteran Boulder, Kirk, Roubaix, Deadman, and Boxelder timber sales. Specialist reports for each of these sales noted no significant impacts, although effects were discussed. Water yield increases were noted as possible, but not significant, for the Veteran Boulder and Roubaix sales and were not expected for the Kirk, Deadman, and Boxelder sales. Water quality, or soil health, were not expected to be significantly impacted if South Dakota Best Management Practices, Watershed Conservation Practices and Forest Plan Standards and Guidelines were implemented as recommended (Macy,

1996, 1998a, 1998b, 1999). Based on the information in Macy's 1996, 1998a, 1998b, and 1999 reports it is reasonable to assume that there have been no major changes to watershed class within the project area.

Table 11 Summary of Natural Watershed Sensitivity and Impact Indices, and Watershed Class*

| Current Watershed Number | 1996 Forest Plan Watershed Number | Old Watershed Name | Old watershed # Natural Watershed Sensitivity Index (NWSI) | Old watershed # Impact Index | Old Watershed # Watershed Class |
|--------------------------|-----------------------------------|--------------------|--|------------------------------|---------------------------------|
| 10120202070101 | 90-01 | Alkali Creek | 58.85 | 23.64 | II |
| 10120111010103 | 89-01 | Box Elder Creek | 37.47 | 20.62 | II |
| 10120111010204 | 89-01 | Box Elder Creek | 37.47 | 20.62 | II |
| 10120111010301 | 89-01 | Box Elder Creek | 37.47 | 20.62 | II |
| 10120111020102 | 88-01 | Elk Creek | 56.83 | 38.65 | III |
| 10120111020103 | 88-01 | Elk Creek | 56.83 | 38.65 | III |
| 10120111020104 | 88-01 | Elk Creek | 56.83 | 38.65 | III |
| 10120111020305 | 88-01 | Elk Creek | 56.83 | 38.65 | III |
| 10120111020301 | 88-01 | Elk Creek | 56.83 | 38.65 | III |
| 10120202020105 | 88-02 | Elk Creek | 52.84 | 33.36 | III |
| 10120111020201 | 88-04 | Elk Creek | 43.23 | 25.5 | III |
| 10120202060102 | 87-01 | Bear Butte Creek | 70.12 | 32.73 | III |
| 10120202060103 | 87-01 | Bear Butte Creek | 70.12 | 32.73 | III |
| 10120202060104 | 87-01 | Bear Butte Creek | 70.12 | 32.73 | III |
| 10120202060105 | 87-01 | Bear Butte Creek | 70.12 | 32.73 | III |
| 10120202060106 | 87-01 | Bear Butte Creek | 70.12 | 32.73 | III |
| 10120202060202 | 87-02 | Bear Butte Creek | 48.24 | 16.65 | II |
| 10120111010103 | 86-01 | Whitewood Creek | 83.5 | 37.63 | III |
| 10120111010204 | 86-01 | Whitewood Creek | 83.5 | 37.63 | III |
| 10120111010301 | 86-01 | Whitewood Creek | 83.5 | 37.63 | III |

*FEIS, 1996, Appendix J

Soils, Erosion, Compaction, Heating, and Nutrient Loss

The dominant soils within the project area are the Citadel, Vanocker Citadel, and Grizzly Virkula soils of Lawrence County, and the Citadel and Vanocker-Citadel Associations of Meade County. Their characteristics are summarized in Table 12 Major Soil Types and Their Characteristics of the Elk Bugs and Fuels Project Area.. Because the soil characteristics varied slightly between counties for the Citadel soil/Citadel Association and the Citadel Vanocker soil/Citadel Vanocker Association, these soils were listed separately in the following table.

Table 12 Major Soil Types and Their Characteristics of the Elk Bugs and Fuel Project Area.

| <i>Soil Name</i> | <i># Acres in Project Area</i> | <i>Slope Range</i> | <i>Mass Movement Potential*</i> | <i>Erosion Potential*</i> | <i>% Ground Cover Needed to Control Erosion</i> | <i>Concerns Related to Road Building**</i> |
|------------------------------|--------------------------------|--------------------|---------------------------------|---------------------------|---|--|
| Citadel | 9358 | 10-30% | Some | Moderate | 40-70 | 1 |
| Vanocker-Citadel | 12938 | 25-60 | Some | Moderate To Very High | 70-95 | 1, 2, 3,4 |
| Grizzly-Virkula | 5063 | 25-60 | Some | Moderate To Very High | 75-90 | 1, 2, 5 |
| Citadel Association | 6542 | 15-25 | High | High | 40-70*** | 6 |
| Vanocker Citadel Association | 11756 | 25-60 | High | High | 70-95*** | 6 |

* when disturbed

** 1: Road slippery when wet;

2: Construction on steep slopes result in long cut and fill and increased erosion

3: Cutslope slumping and road failure may occur after construction;

4: Avoid active landslide and wet seepy areas

5: Cutslope slumping may occur where rock layers are parallel to cutslopes;

6: A decrease in rock fragments may result in spongy roadbed.

7: steep slopes, low shear strength, and high shrink-swell potential

***NRCS, J.Westerman, Personal Communication, 2003

In 2002, the western portion of the project area was involved in the Grizzly Gulch fire. Burn severity relates directly to the effects of fire on soil conditions and hydrologic function, such as soil structure, the amount of surface litter and duff, infiltration rates and runoff response. Soils in the Pee Dee Gulch and Two Bit Gulch areas were moderately burned while soils in the Dome, Bear Den, and Pillar Peak areas experienced high severity burns (Interagency Baer Report, 2002). In areas of high burn severity, the fire consumed all the forest floor litter and duff, leaving no groundcover, and the soils are characterized by hydrophobic, or water repellency.

Although there is a natural degree of water repellency to these soils, it is expected that natural erosion rates will increase due to the hydrophobic soils (Interagency Baer Report, 2002). In Two Bit Gulch the dominant soils are Citadel, Grizzly-Virkula, and Maitland

(9-50%). Grizzly-Virkula and Vanocker-Citadel are the major soil types present, while in the Dome/Bear Den/Pillar Peak areas the principal soils are Grizzly-Virkula and Virkula soils. Erosion rates for these soils, once they have been disturbed, range from low to very high.

Modeling was conducted to estimate pre and post-fire erosion rates, using the modified Revised Universal Soil Loss Equation (RUSLE). The equation has been modified for use on national forests. Modeling projected a six-fold increase in post fire erosion rates for the Two-Bit Gulch area and a four fold increase in the Pee Dee Gulch area relative to existing erosion rates (Interagency Baer Report, 2002). However, monitoring post-fire in 2002, and in 2003, did not document ash or sediment, from the fire, within the drainages of the Pillar Peak, Dome Mountain or Bear Den Mountain areas. In 2003, monitoring documented that the severely burned hillslopes showed little evidence of sediment movement, rills or surface filling on the hillslope. Natural regrowth of vegetation was observed and was providing groundcover (Tangenberg 2003).

Within the project area the other soil types found include: Marshdale-Maitland, Maitland, Nevee, Nevee Spearfish, Paunsaugant with Rock Outcrop, Vanocker with Rock Outcrops, Savo, St. Onge, Tilford, Virkula, Hisega, Vale and Winetti.

Of these soils, Maitland, some Nevee and Vale, Nevee Spearfish, Paunsaugant and Vanocker with Rock Outcrop, and Hisega have moderate to very high erosion potentials when disturbed. The sources for these erosion potentials range from the steep slopes associated with the soil, the underlying geology, or from concentration of water in streams, ditches or trails (Lawrence County Soil Survey, 1979). St. Onge, Tilford, Savo, and Winetti soils have low erosion potentials that are associated with their position in valley bottoms and lowlands.

The Lawrence County soil survey did not document any mass movement locations in their soil surveys but they did note their existence (NRCS, 1979 and 1978). Mass movement potential by soil type is documented in the 1979 Lawrence County Soil Survey and is summarized in Table 13. Although the Meade County Survey did not address mass movement potential in describing soil characteristics, erosive potential was noted. Based on the similarity in erosive characteristics for these soil types between counties, and discussions with NRCS personnel, it is assumed that the mass movement potential for Vanocker/Citadel and Citadel Association is the same as in Lawrence County.

All soils, except the Citadel Soil (Lawrence Co.)/Citadel Association (Meade Co), are typically found on slopes of 25-60% or somewhere near these percentages. For Grizzly-Virkula and Hisega soils the mass movement potential appears to be related to the underlying geology. When underlying rock layers are parallel to topography, the layering in the rock acts as a conduit for water infiltrating into the subsurface, facilitating slope failure. This geological influence and the associated slope gradients of 25-60% increase the potential for soil erosion, the slumping of cut slopes associated with roads, and landslides.

All soils listed in Table 13 have moderate to very high erosion potentials, when disturbed. This means that if slope failure occurs, associated soils will be even more susceptible to erosion.

Citadel soils in Lawrence County are classified as having “some” mass movement potential, but slopes range from only 10-30%. Wet seepy areas and old landslides (although none were noted during NRCS mapping) were documented as having some potential (NRCS 1979). NRCS 1979 suggests that old landslides may be present in Maitland soils but none were noted during mapping. Citadel soils are moderately to highly susceptible to erosion once disturbed while Maitland soils range from moderately to very highly susceptible to erosion once disturbed (NRCS, 1979). Soil distribution is summarized as Map 2, and is located in Section C.1.1 of the Project File. Table 14 lists by watershed, the acreage for the soils listed in Table 13, and the amount of road mileage on that soil type.

Table 13 Soils with Mass Movement Potential

| | Vanocker-Citadel/Vanocker Citadel Assoc. (VBF/VaE) | Citadel/Citadel Association (CBE/CtE)* | Grizzly-Virkula (GBE) | Hisega (HBF) | Maitland (MaD) | Vanocker w/ Rock Outcrop (RCF) |
|--|---|---|--|--|-----------------------|---------------------------------------|
| Slope Range % | 25-60 | 10-30 | 25-60 | 25-60 | 9-50 | 30-75 |
| Mass Movement Potential | Some | Some potential | Some potential where rock layers are parallel to slope | Some potential where rock layers are parallel to slope | Some potential | Some |
| Erosion Potential-when disturbed | M-VH | M-H | M-VH | M-VH | M-VH | H to VH |
| Road Related Slope Stability Concerns | 1, 3, 4** | 5 | 1, 2 | 1, 2 | 5 | 4, 3 |

*CBE/CtE: where one soil has two abbreviations this denotes a name change between Lawrence and Meade Counties. The code for Lawrence County is listed first.

** Definitions for road related slope stability concerns are:

1. Construction on steep slopes result in long cut and fill slopes, which increase soil erosion
2. Cutslope slumping when rock layers are parallel to the slope
3. Landslide areas may be present as well as wet and seepy areas.
4. Cut-slope slumping and road failure may occur after road construction on steep slopes
5. No mass wasting concerns noted other than Erosion Potential Rating
6. Rockslides may be present

Table 14 Soils with Mass Movement Potential, Their Acreage, and Number of Road Miles on Each Soil Type

| Watershed Number | Soil Type | Acreage | Road Miles |
|-------------------------|------------------------------|----------------|-------------------|
| 10120202070101 | Citadel Association | 232 | 0 |
| 10120202060202 | Citadel Soil | 437 | 4.18 |
| 10120202060106 | Vanocker-Citadel Association | 3302 | 10.86 |
| | Citadel Soil | 1239 | 11.24 |
| 10120202060105 | Vanocker-Citadel | 645 | 2.3 |
| | Vanocker-Citadel Association | 109 | 0.42 |
| | Vanocker With Rock Outcrop | 185 | 0.94 |
| | Citadel Association | 268 | 91.58 |
| | Citadel Soil | 967 | 9.08 |
| 10120202060104 | Vanocker-Citadel | 2338 | 11.88 |
| | Grizzly-Virkula | 3031 | 6.64 |
| | Maitland (9-50%) | 367 | 2.52 |
| | Citadel Soil | 1532 | 12.13 |
| 10120202060103 | Vanocker-Citadel | 2319 | 18.65 |
| | Grizzly-Virkula | 1088 | 6.35 |
| | Citadel Association | 337 | 3.05 |
| | Citadel Soil | 1128 | 10.60 |
| 10120202060102 | Vanocker-Citadel | 3365 | 15.61 |
| | Hisega | 248 | 2.12 |
| | Grizzly-Virkula | 834 | 4.53 |
| | Citadel Association | 36 | 0.34 |
| | Citadel Soil | 2051 | 21.67 |
| 10120202020105 | Vanocker-Citadel | 3389 | 14.85 |
| | Vanocker With Rock Outcrop | 7112 | 2.09 |
| | Grizzly-Virkula | 98 | 0.77 |
| | Citadel Soil | 1599 | 11.57 |
| 10120111020305 | Citadel Association | 278 | 3.94 |
| 10120111020301 | Citadel Association | 20 | 0.31 |
| 10120111020104 | Vanocker-Citadel | 32 | 0.36 |
| | Citadel Association | 1074 | 10.6 |
| 10120111020103 | Vanocker-Citadel | 508 | 3.21 |
| | Hisega | 1 | 0.1 |
| | Citadel Association | 2512 | 23.86 |
| | Citadel Soil | 651 | 5.14 |
| 10120111020102 | Vanocker-Citadel | 987 | 3.62 |
| | Hisega | 2202 | 10.54 |
| | Grizzly-Virkula | 12 | 0.27 |
| | Citadel Association | 546 | 4.75 |
| | Citadel Soil | 993 | 11.37 |

Although Citadel/Citadel Association and Maitland soils are noted as having mass movement potential the only road concerns noted in the Lawrence County Survey was that roads through these soil types may be slippery when wet. Table 15 below summarizes soils characteristics related to potential road concerns.

Table 15 Soils Characteristics Related to Potential Road Concerns

| Soil Type | Road Concern |
|---------------------------------------|---|
| <i>Grizzly-Virkula (GBE)</i> | <ul style="list-style-type: none"> • Without gravel, roads are slippery when wet • Steeper slopes may have increased erosion on long cut and fills • Cutslope slumping when rock parallel to slope |
| <i>Hisega (HBF)</i> | <ul style="list-style-type: none"> • Fractured bedrock 1.5-3 ft and outcrops present construction problems • Some slumping of cut-slopes may occur where rock layers parallel cut-slopes • May include spongy areas which have few rock fragments. |
| <i>Maitland (MaD)</i> | <ul style="list-style-type: none"> • Old landslides may be present • Avoid activities on active slides and wet seepy areas |
| <i>Vanocker w/ Rock Outcrop (RCF)</i> | <ul style="list-style-type: none"> • Steep slopes and rock outcrops present construction problems • Large boulders present in association with outcrops • Some slumping of cut-slopes may occur where rock layers parallel cut-slopes • Landslide areas may be present as well as wet and seepy areas. • Clay soils components will need gravelling |
| <i>Vanocker Citadel (VBF/VaE)</i> | <ul style="list-style-type: none"> • Steep slopes present construction problems. Construction on steep slopes result in long cut and fill slopes, which increase soil erosion • Citadel components will require gravelling • Cut-slope slumping and road failure may occur after road construction on steep slopes • Landslide areas may be present as well as wet and seepy areas. |

Stream Flow Regimes

Flow regimes within the project area range from ephemeral to intermittent to perennial. Ephemeral reaches are typically dry, grassy or timbered swales that carry water infrequently and during intense runoff-events. They typically do not have any evidence of recent flow, their channels are not defined, and there is a lack of channel scour, which exposes gravel and or sandy substrates (Tangenberg, 2003, pg. 3; South Dakota Forestry BMPs-Best Management Practices, updated, pg. 18).

Flow regimes are highly influenced by both climate and the underlying geology. Base flow of most streams in the Black Hills begins in the higher elevations where there is more precipitation relative to evapotranspiration. However, base flow of streams often can't be maintained where streams cross the Madison/Englewood and Minnulusa Formations. As a result, the large numbers of intermittent streams within the project area are formed. Even large streams which are considered "perennial" in nature include intermittent reaches where base flow can't be sustained due to the secondary permeability found within the Madison/Englewood and Minnulusa formations. Perennial streams within the study area include: Elk, Bear Butte, Boulder, Meadow and Park creeks.

As surface water and groundwater are intimately connected in the Black Hills, both aquifers are highly susceptible to contamination due to the large amount of secondary permeability and recharge related to surface waters (FEIS, 1996, pg. 111-37, Driscoll, et al. 2002, pg. 60). The most damaging floods in the Black Hills are related to severe spring and summer thunderstorms. Typically, snowmelt is not a significant factor in affecting storm runoff. However, during April, May, and June, soils moisture conditions are typically high as this is when the majority of precipitation is received (See Climate and Watershed section).

Water Quality

Water quality refers to the physical, chemical and biological components of a given stream and its assigned beneficial uses. In 1972 the Federal Water Pollution Control Act Amendment of 1972 was passed. This act, more commonly known as the Clean Water Act (CWA), regulates the discharges of pollutants into the waters of the United States and was intended to maintain and restore the chemical, physical, and biological integrity of the Nation's waters. Waters of the US include perennial and intermittent streams (R2 WCPH, pg. 4 of 4; www.epa.gov/region5/water/cwa.htm).

Section 305(b) of the CWA also requires the establishment and implementation of water quality standards and criteria. It also requires each state to conduct water quality surveys to determine a water body's overall health, including whether or not basic uses are being met. States, tribes, and other jurisdictions define appropriate uses for a waterbody and incorporate these uses into water quality standards that are approved by the Environmental Protection Agency (EPA). Water body uses include aquatic life protection, fish and shellfish production, drinking water supply, swimming, boating, fishing, and agricultural irrigation, among others (<http://www.epa.gov/unix0008/water/305b/305what.html>).

South Dakota has assigned a minimum beneficial use of wildlife propagation, stock water and irrigation to all streams. Page III-72, 1996 Forest Plan FEIS defines South Dakota stream classes and beneficial uses as follows:

- Class 1s-domestic water supply
- Class 2s-coldwater permanent fish life propagation waters
- Class 3s-Coldwater marginal fish life propagation waters
- Class 7s-Immersion recreation waters
- Class 8s-Limited contact recreation waters
- Class 9s-Wildlife propagation/stock watering/irrigation (rec)
- Class 10s-irrigation

Section 313 of the CWA requires the Forest Service to comply with water quality laws and rules, coordinate actions that affect water quality with the States, and control nonpoint-source pollution. Sections 208, 303, and 319 require the Forest Service to apply Best Management Practices (BMPs), considering local factors, to control nonpoint-source pollution and meet water quality standards (R2 WCPHB, 1999).

Table 16 documents designated Stream Class and Beneficial Uses within the project area. The table includes the names of streams in the study area for which data was available.

**Table 16 Summary of Beneficial Uses for Designated Stream Segments
Within the Project Area**

| Name | Designated Stream Segment | Beneficial Use Stream Class |
|------------------|--|------------------------------------|
| Alkali Creek | From Interstate 90 to S4, T4N, R5E of the Black Hills Meridian | 1, 3, 8, 9 and 10 |
| Bear Butte Creek | S 2 T4N, R4E | 2, 8, 9, and 10s |
| Boulder Creek | From Bear Butte Creek to Two Bit Creek | 3s, 8s, 9s and 10s |
| Two Bit Creek | From Boulder Creek To S30, T5N, R4E | 3s, 8s, 9s and 10s |
| Park Creek | From Bear Butte Creek To S11, T4N, R4E | 3s, 8s, 9s and 10s |
| Vanocker Creek | From Bear Butte Creek To S32, T5N, R5E | 3s, 8s, 9s and 10s |
| Meadow Creek | From Elk Creek To S25, T4N, R4E | 3s, 8s, 9s and 10s |

Table 17 summarizes streams with known beneficial uses flowing through the project area, but do not have designated stream reaches within the project area. The beneficial uses for these streams are provided for informational purposes. The beneficial uses for stream segments, within the proposed project area and downstream, were determined from the State of South Dakota's Surface Water Quality Standards, Chapter 74:51:03.

Table 17 Summary of Beneficial Uses for Streams Crossing Through the Project Area, But Without Designated Stream Segments

| | |
|-----------------|-----------------------|
| Elk Creek | 2s, 7s, 8s, 9s |
| Whitewood Creek | 2s, 7s, 8s, 9s*, 10s* |

* The asterisked designations for Class 9s and 10s denote a difference between the Forest Plan and the State of South Dakota. The Forest Plan defines Class 9s as wildlife propagation/stock watering/irrigation. The State defines Class 9s as Fish/Wildlife propagation/recreation/stock and places irrigation in Class 10s.

The EPA requires states to enforce water quality standards for surface waters and provide a report to the EPA every two years. Section 305(b) of the report documents those water bodies that are not meeting water quality criteria. Section 303 (d) requires states to identify waters for which effluent limitations are not stringent enough to meet water quality standards (http://www.state.ma.us/mgis/mgic/10_00/dallaire/sld008.htm). For 2002, only one stream reach within the project area is designated as impaired on the State's 305(b) and 303(d) lists. That reach is on Whitewood Creek, from Spruce Gulch to Sandy Creek. In the 305(b) report it was listed for pathogens, suspended solids, and thermal modifications. It is listed as impaired for fecal coliform, suspended solids, and temperature on the 303(d) list.

Although the state does not have a monitoring site on Elk Creek, the Forest monitored water quality on the creek from 1982 through 1996. Violations of state water quality criteria for water temperature, pH, and total suspended solids occurred intermittently (FEIS, 1996, III-82).

Water-Road Interactions, Sediment and Connected Disturbed Areas

A full inventory and discussion of existing road conditions within the project area can be found in the Roads Analysis Report located in Section D of the Project File.

Existing overall road densities are summarized below in Table 18. The densities were calculated by dividing the total number of road miles, for Forest Service and other roads, by the total acreage within the watershed.

Table 18 Existing Overall Road Densities for Portions of Watersheds Located Within the Project Area

| <i>Watershed Number</i> | <i>Road Density (mi./sq. mi)</i> |
|-------------------------|----------------------------------|
| 10120111020102 | 3.5 |
| 10120111020103 | 3.6 |
| 10120111020104 | 3.4 |
| 10120111020301 | 9.7 |
| 10120111020305 | 3.7 |
| 10120202020105 | 2.7 |
| 10120202060102 | 3.7 |
| 10120202060103 | 4.6 |
| 10120202060104 | 2.2 |
| 10120202060105 | 4.7 |
| 10120202060106 | 2.4 |
| 10120202060202 | 4.5 |
| 10120202070101 | 0.6 |

Watersheds highlighted in gray are located entirely within the project area. As a result, the overall road densities reflect the existing condition for the entire watershed. Road densities for these watersheds range from 2.2 - 4.6 mi./sq. mi. Watersheds that are not highlighted only have part of their area located within the project boundary. For these watersheds the road densities are a function of the amount of area, for that watershed,

located within the project boundary. It should be noted that 26 acres of Watershed 101202111020301 is located within the project area boundary. This portion of the watershed is not in the Beaver Park roadless area.

The location of roads, relative to streams is especially important, as they are the single largest source and delivery system of sediment to channels (FEIS, 1996, pg. III-73). Roads intercept both surface and ground water. Waters running down and off road surfaces can enter directly into a creek or through associated road ditches emptying into streams. Roads result in lower infiltration rates and can affect groundwater when they are located near springs (Tangenberg, 2002). These factors can result in increased sediment delivery to streams as well as higher peak flows and accelerated timing of peak flows (Tangenberg 2002, Nelson 2002).

Accurately monitoring and estimating the amounts of sediment delivery is very difficult due to the large number of variables involved. As a result, the affected environment will be discussed in terms of potential sediment sources. A distance of 300 ft was selected to ensure that the effect of all potential runoff was evaluated (Nelson 2002). Preliminary GIS analysis determined that portions of approximately 413 roads were within 300 ft of streams in the project area. A list of these roads is found in the roads analysis report, Section D of the Project File.

Road density (miles of road/square mile) within 300 ft of streams provides a relative measure of road-stream interaction and the relative risk for increases flows and sediment input into the hydrologic system. It also allows comparison between watersheds within the project area. Areas with higher road densities within 300 ft of streams are at greater risk for modification of flow and sediment loading.

Table 19 displays road densities, by ownership, within 300 ft of streams. The row designated “NFS” shows Forest Service roads while “Other” indicates road densities for roads in other than Forest Service ownership. Watersheds highlighted in gray are located entirely within the project area and the stated road densities reflect existing conditions in the entire watershed. Forest Service road densities were calculated by totaling the miles of Forest Service road divided by the number of acres of Forest Service land within 300 ft of streams. Road densities for the “Other” category was calculated by dividing the number of miles of non-Forest Service roads was divided by the number of acres of non-forest service land.

Table 19 Summary of Road Densities within 300 ft of Streams, By Ownership and Watershed Number (# Miles/Sq. Miles)

| Watershed # | NFS | Other |
|----------------|-----|-------|
| 10120111020102 | 4.7 | 1.2 |
| 10120111020103 | 4.1 | 5.1 |
| 10120111020104 | 2.2 | 3.5 |
| 10120111020301 | 0 | 0 |
| 10120111020305 | 4.2 | 3.4 |
| 10120202020105 | 3.8 | 2.9 |
| 10120202060102 | 6.6 | 2.7 |

| Watershed # | NFS | Other |
|----------------|-----|-------|
| 10120202060103 | 6.4 | 6.6 |
| 10120202060104 | 3.1 | 1.9 |
| 10120202060105 | 3.4 | 6.0 |
| 10120202060106 | 3.4 | 4.1 |
| 10120202060202 | 6.9 | 13.8 |
| 10120202070101 | 0.2 | 2.0 |

For watersheds located entirely within the project area, Forest Service road densities within 300 ft of streams, ranges from a low of 3.1 mi/sq. mi (watershed 10120202060104) to a high of 6.6 mi/sq. mi (watershed 10120202060102). Watersheds 10120202060102 and 60103 have the largest potential for road influence on hydrology and sediment due to their densities of 6.6 and 6.4 mi/sq. mi. respectively. This is due to not only the higher number of road miles but also to the predominant road surface type. The majority of the roads found in the project area are surfaced naturally or with aggregate. Both these surface types have higher potential for contributing sediment via surface runoff than pavement. Watershed 10120111060104 has the lowest road densities and the lowest relative measure of road-stream interaction. Road densities on “Other” lands range from 1.2-6.6 mi./sq. mi.

For watersheds located partially within the project area, Forest Service road densities range from 0-6.9 mi./sq. mi while on “Other” land the road densities range from 0 to 13.8 mi/sq. mile. Watershed 10120202060202 has a very high road density within 300 ft of streams, however, only a small portion of that watershed is located within the project area. Watershed 10120111020301 also has only a very small portion located within the project area. Typically “Other” road densities are less than Forest Service riparian road densities, which is a function of land ownership. Connected Disturbed Areas (CDAs) are included as potential sediment sources associated with roads. Existing CDAs were mapped during the 2002 field season. CDAs occur where roads contribute water and sediment directly to streams through surface erosion (Ohlander, 1998). More information on CDAs, and on the influence roads have on project area hydrology, can be found in the Roads Analysis Report located in Section D of the Project File.

Riparian Areas and Wetlands

The term, “wetlands” is generic, referring to areas that are not totally terrestrial or fully aquatic. Wetlands classification is based on the source type of the water for the area and includes precipitation, ground water and surface water dominated systems. Surface water dominated wetlands are referred to as riparian systems (<http://h20sparc.wq.ncsu.edu/info/wetlands/types3.html>). Riparian areas adjacent to streams were identified by analysis of the Forest Service’s GIS riparian layer. Wetlands within the project area were evaluated using maps obtained from the U.S. Fish and Wildlife Service (USFWS).

Roads located within riparian areas have the potential to compact soils, increase erosion, introduce sediment, affect surface and subsurface water relationships, and modify flood protection function. Table 20 summarizes road densities within the riparian zone.

Table 20 Summary of Road Densities within the Riparian Zone, By Ownership and Watershed Number (mi/sq. miles)

| Watershed # | NFS | Other |
|----------------|------|-------|
| 10120111020102 | 4.1 | 1.6 |
| 10120111020103 | 6.3 | 8.9 |
| 10120111020104 | 2.1 | 2.3 |
| 10120111020301 | 0 | 0 |
| 10120111020305 | 6.8 | 6.0 |
| 10120202020105 | 5.5 | 3.9 |
| 10120202060102 | 6.3 | 2.7 |
| 10120202060103 | 12.6 | 5.0 |
| 10120202060104 | 4.2 | 0.6 |
| 10120202060105 | 3.8 | 6.8 |
| 10120202060106 | 5.6 | 6.6 |
| 10120202060202 | 4.9 | 21.6 |
| 10120202070101 | 0 | 4.3 |

Watersheds highlighted in gray are located entirely within the project area and the road densities reflect riparian zone road densities for the entire watershed. For watersheds located completely within the project area boundary, Forest Service riparian road densities range from 4.1 – 12.6 mi./sq. mile. Watershed 10120202060103 has the highest road density of 12.6 mi./sq. mile. All the other watersheds, except for 10120111020104, have similar road densities ranging from 4.1-6.8 mi./sq. mile. Road densities range from 1.6 – 8.9 mi./sq. mile on non-Forest Service land within the project area.

Watersheds with only a portion of their area located within the project have densities ranging from 0 – 21.6 mi./sq. mile. Watersheds 10120111020301 and 10120202060202 have only small portions of their area within project boundary. The densities of “0” and 21.6 mi./sq. mile do not reflect road densities within the riparian zone for the entire watershed, but are the road densities for the small portions of the watershed within the project area (See Table 20).

Table 21 summarizes roads that are currently located in or adjacent to wetlands as mapped by the Fish and Wildlife Service in 1995. All but one of the wetlands are related to road activity or construction of stock ponds as defined in the USFWS codes, which are explained following Table 21.

Table 21 Summary of Roads Affecting Wetlands Mapped By US Fish and Wildlife, 1995 (USFWS, 1995)

| Watershed Number | Road | Wetland Type |
|-------------------------|-----------------------------|---------------------|
| 10120111020102 | | |
| | 575.1B | PEMCh* |
| | Unauthorized and Unnumbered | PEMCh and PABFh |
| | CO 044 | PEMCh |
| 10120111020103 | | |
| | Unauthorized and Unnumbered | PABFh |
| | FH 26 | PABFh |
| 10120202060102 | | |
| | Unauthorized and Unnumbered | PABFh |
| | 180.1 | PABFh |
| 10120202060105 | US Highway 14A | PABFh and PSSA |

*Definitions are from the USFWS Wetlands Definition Key.

U: uplands

PEMCh: Palustrine, emergent, seasonally flooded, diked/impounded

PABFh: Palustrine, aquatic bed, semi-permanently flooded, diked/impounded

PSSA: Palustrine, scrub, shrub, temporarily flooded

Channel Morphology

Streams systems are complex and dynamic. Channel morphology, including streambed and streambank stability, reflects a balance between streamflow, sediment input, and substrate/bank composition (Macy, 1996a). As one component of this triad varies a corresponding change results in the other two. As a result, changes in channel morphology (shape), stability and changes in the streambed or streambank are often seen, especially over time. Increases in peak flow increases the energy available for sediment transport and bank erosion. Increases in sediment input result in a decrease of energy available for erosion, deposition of sediment, channel widening and a decrease in bankfull depth (Macy 1996a).

Within the analysis area, the majority of drainages are either ephemeral or intermittent. Ephemeral channels typically appeared stable and vegetated and were defined by a swale type morphology. No evidence of flow was observed (Fryxell 2002). Intermittent channels observed in the area exhibited bank incision, vegetation oriented with the long axis downstream, and localized areas of larger substrate (Fryxell 2002).

Perennial streams within the project area include: Elk Creek, Bear Butte Creek, Boulder Creek, Meadow and Park Creek. These streams show evidence of erosion and deposition, which included bank scour, pools, mid channel and point bars. Field verification of stream reaches within the Kirk, and Boxelder, and the Veteran Boulder timber sales documented stream reaches as 90% or more stable or mostly stable (Macy, 1996b, 1998a, 1998b). These sales were located partially, or entirely within, the proposed project area. Major channel modifications are related to periods of high run-off that is associated with

severe spring and summer thunderstorms, rain on snow events, and long lasting intense storms (FEIS, 1996, III-64). April, May and June have the highest mean precipitation with 3.07, 4.09 and 4.01 inches per month, respectively. However, no major flooding within the project area has occurred since 1996. As a result, it is assumed that channel morphology is essentially the same as described in these reports.

Some modifications to channel morphology, in association with roads were identified. Localized modifications were typically “fill in channel” or much less frequently, damaged culverts. Modifications were typically found in association with ephemeral or intermittent drainages (Fryxell, Roads Analysis Report, 2003).

Floodplains

Floodplains within the project are most affected by roads and their location with respect to the individual drainages. Flood plain dynamics, channel migration, flow volumes and velocities can be modified when roads are located within a channels flood plain, especially when channel locations have been modified to accommodate road placement. As a result of road placement within floodplains, the ability of channel to migrate, change flow volumes and modify its channel morphology is altered. Roads also affect the ability of a system to distribute floodwaters.

Table 22 lists major streams with modified physical channel dynamics.

Table 22 List of Streams with Modified and/or Isolated Floodplains

| Road Number | Stream (Name if Available) | Type of Modification |
|--------------------|---------------------------------------|---|
| 699.1 | Sandy Creek | Road in drainage bottom; Road surface erosion and ditches emptying directly into creek adding to channel sediment load; Channel straightened and prevented from channel migration, some “rip-rap” like lining of channel. |
| US 14 A | Boulder Creek | Road in drainage bottom, restricts lateral migration, channel rip-rapped and straightened |
| FH 26 | Meadow Creek | Floodplain isolation and disruption |
| FH 26 | Big Elk Creek | Floodplain isolation and disruption |
| 170.2 | Vanocker Creek | Road crosses creek multiple times; Closely parallels creek. Channel moved around to fit in road. Road |

| Road Number | Stream (Name if Available) | Type of Modification |
|--------------------|---------------------------------------|---|
| | | side cast functioning as riparian on one bank. |
| 180.1 | Park Creek | Floodplain Disruption |
| 135.2C | Unnamed | Road has intercepted channel floodplain; Road surface erosion adding sediment to floodplain |
| 536.1 | Elk Creek | Initial crossing causing accelerated erosion on downstream outerbank, ruts, sediment from road into creek |

Map evaluation indicates that the following non-system roads cross drainages multiple times or appear to be located within drainage bottoms and would likely affect sediment transport, channel migration, floodplain integrity, and may modify flows. These roads are summarized below in Table 23.

Table 23 Roads Crossing Streams Multiple Times or Located in Drainage Bottoms

| | |
|----------|----------|
| U030030 | U080042B |
| U040012 | U080046 |
| U040040A | U080049 |
| U070021C | U080059A |
| U070012B | U080059C |
| U070024 | U080059D |
| U070037 | U080071 |
| U070066 | U080088 |
| U080014A | U080127 |
| U080015 | U080155 |
| U080017 | U080117 |
| U080017A | U080118 |
| U080018 | U090004 |
| U080019B | U090005 |

Other Activities within the Project Area Influencing Hydrology

Grazing and mining have been historical activities within the project area. With the project area are four active grazing allotments and four inactive allotments. The four active allotments are the Bear Butte, Runkle, Elk, and Crook Mountain Allotments (Smith, 2003).

Bear Butte Allotment is mostly within Elk Creek, with minor portions in the Virkula drainage. Major drainages within the Runkle Allotment are Elk Creek, Meadow Creek, Dry Elk, and Virkula. Other drainages are included in the allotment, but are outside the

project area. The portion of the Elk Allotment, which is within the project area, is found in the Little Elk and Elk Creek drainages. Whitewood Creek and Sandy Creek are the major drainages in the Crook Mountain allotment. All of the allotments include riparian zones associated with these streams and various cold water fisheries are also present (Smith, Tom, 2003a, 2003b).

Grazing improvements included water developments, cattle guards, and fencing for the Runkle, Elk, and Crook Mountain allotments (Smith, Tom, 2003b).

Historically there has been mining within the project area. Currently there are no active mines within the project area on FS land and there are no abandoned mines that have any issues associated with them on the forest. There are three mines on private property with associated issues (D. Murray, 2003, Personal Communication). The Guilt Edge mine is located just outside of the project boundary and has resulted in Strawberry Creek being on both the 305(b) and 303(d) lists. Water quality analytes of concern are metals, conductivity, salinity, total dissolved solids, and total suspended solids (State of South Dakota, Dept. of Environment and Natural Resources, 2002a, 20002b). The mine is a superfund site and cleanup is ongoing. The junction between Strawberry Creek and Bear Butte Creek is located at the project boundary.

Double Rainbow mine on Bear Butte Creek is located one mile before Galena. There have been problems associated with acid rock drainage, due to mine tailings located on a spring. Clean up has been done and inspections to determine compliance will be done in the near future. Elk Creek has some minor problems associated with arsenic levels related to the Uncle Sam mine, near the old town of Roubaix. These levels are minor and active clean up is not being pursued at this time.

Environmental Consequences

Direct and Indirect Effects

Table 24 summarizes, by alternative, the number of acres of soils proposed for treatment which have mass movement potential and moderate to very high erosion potentials, once the soils have been disturbed (NRCS, 1979). Soils included as having mass movement potential are: the Citadel/Citadel Association, Grizzly-Virkula, Hisega, Vanocker Rock Outcrop, and the Vanocker-Citadel/Vanocker-Citadel, and Maitland (9-50% slopes). These soils also have moderate to very high erosion potential, once they are disturbed, as well as the Nevee (6-9% slopes), Nevee-Spearfish and Paunsaugant Rock Outcrop soils (NRCS, 1978, 1979). Although these soils comprise a high percentage of the project area, several limitations should be noted. Soil survey maps have been done at a broad scale and detail is limited.

Other soils listed in the affected environment, and not listed here, do not have mass movement potential or the moderate to very high erosion potential once they are disturbed. The total number of acres proposed for commercial thinning and fuel breaks was calculated by adding together all the acreages where these two prescriptions were either the sole method prescribed or were used in combination with another method. The total acreage for the prescribed burns was calculated the same way. The table summarizing acreage totals for each type of individual prescription is found in Appendix D.

Table 24 Soil Effects and Treatments Summary

| Watershed # | # Acres of Soil With Mass Movement Potential Within the Project Area | # Acres of Soil With Moderate To Very High Erosion Potential Within the Project Area | Total Number of Acres Proposed for Treatment | Total Number of Acres Where Commercial Thinning and Fuel Breaks are Included in the Prescription | Total Number of Acres Where Prescribed Burning is Included in the Prescription |
|-----------------------------|--|--|--|--|--|
| <i>Alternative 1</i> | | | | | |
| 10120111020102 | 5118 | 6634.9 | 0 | 0 | 0 |
| 10120111020103 | 7457 | 7457 | 0 | 0 | 0 |
| 10120111020104 | 4431.7 | 4601.2 | 0 | 0 | 0 |
| 10120111020301 | 2379 | 0 | 0 | 0 | 0 |
| 10120111020305 | 4583.4 | 4583.4 | 0 | 0 | 0 |
| 10120202020105 | 5797.9 | 5797.9 | 0 | 0 | 0 |
| 10120202060102 | 7087.3 | 7087.3 | 0 | 0 | 0 |
| 10120202060103 | 5038.1 | 5050.3 | 0 | 0 | 0 |
| 10120202060104 | 4170.5 | 4538.1 | 0 | 0 | 0 |
| 10120202060105 | 2173.6 | 3131 | 0 | 0 | 0 |
| 10120202060106 | 4845.4 | 4845.4 | 0 | 0 | 0 |
| 10120202060202 | 444.5 | 696.6 | 0 | 0 | 0 |
| 10120202070101 | 1640 | 0 | 0 | 0 | 0 |
| TOTAL ACRES | 55,167 | 54,422 | 0 | 0 | 0 |

| <i>Alternative 2</i> | | | | | |
|-----------------------------|--|--|--|--|---|
| Watershed # | # Acres of Soil With Mass Movement Potential Involved in Proposed Treatments | # Acres of Soil With Moderate To Very High Erosion Potential Involved in Proposed Treatments | Total Number of Acres Proposed for Treatment | Total Number of Acres Where Commercial Thinning and Fuel Breaks are Included in the Prescription | Total Number of Acres Where Prescribed Burning are Included in the Prescription |
| 10120111020102 | 2093 | 2781 | 3049 | 2389 | 58 |
| 10120111020103 | 1107 | 1107 | 1205 | 811 | 12 |
| 10120111020104 | 1206 | 1207 | 1600 | 321 | 225 |
| 10120111020301 | 0 | 0 | 0 | 0 | 0 |
| 10120111020305 | 46 | 46 | 315 | 307 | 0 |
| 10120202020105 | 1169 | 1169 | 1168 | 1051 | 26 |
| 10120202060102 | 817 | 817 | 979 | 863 | 0 |
| 10120202060103 | 481 | 481 | 541 | 437 | 0 |
| 10120202060104 | 420 | 420 | 482 | 454 | 0 |
| 10120202060105 | 253 | 394 | 394 | 328 | 18 |
| 10120202060106 | 635 | 635 | 635 | 468 | 0 |
| 10120202060202 | 0 | 0 | 0 | 0 | 0 |
| 10120202070101 | 19 | 19 | 19 | 0 | 0 |
| TOTAL ACRES | 8246 | 9076 | 10387 | 7429 | 339 |

| | | | | | |
|--|--|--|--|--|--|
| | | | | | |
|--|--|--|--|--|--|

| Watershed # | # Acres of Soil With Mass Movement Potential Involved in Proposed Treatments | # Acres of Soil With Moderate To Very High Erosion Potential Involved in Proposed Treatments | Total Number of Acres Proposed for Treatment | Total Number of Acres Where Commercial Thinning and Fuel Breaks are Included in the Prescription | Total Number of Acres Where Prescribed Burning are Included in the Prescription |
|----------------------|--|--|--|--|---|
| <i>Alternative 3</i> | | | | | |
| 10120111020102 | 1439 | 1962 | 2172 | 1279 | 1151 |
| 10120111020103 | 1391 | 1391 | 1518 | 735 | 619 |
| 10120111020104 | 1131 | 1131 | 1533 | 385 | 761 |
| 10120111020301 | 0 | 0 | 0 | 0 | 0 |
| 10120111020305 | 38 | 38 | 312 | 306 | 228 |
| 10120202020105 | 869 | 869 | 865 | 686 | 421 |
| 10120202060102 | 1120 | 1120 | 1223 | 767 | 740 |
| 10120202060103 | 1042 | 1042 | 1068 | 819 | 458 |
| 10120202060104 | 460 | 460 | 457 | 418 | 2 |
| 10120202060105 | 262 | 263 | 259 | 228 | 81 |
| 10120202060106 | 943 | 943 | 995 | 441 | 408 |
| 10120202060202 | 33 | 119 | 126 | 8 | 32 |
| 10120202070101 | 80 | 80 | 76 | 0 | 61 |
| TOTAL ACRES | 8808 | 9418 | 10604 | 6072 | 4962 |
| <i>Alternative 4</i> | | | | | |
| 10120111020102 | 2452 | 3167 | 3444 | 2501 | 936 |
| 10120111020103 | 1331 | 1331 | 1449 | 851 | 280 |
| 10120111020104 | 1246 | 1247 | 1657 | 321 | 1331 |
| 10120111020301 | 0 | 0 | 0 | 0 | 0 |
| 10120111020305 | 46 | 46 | 315 | 307 | 247 |
| 10120202020105 | 1205 | 1205 | 1205 | 1087 | 114 |
| 10120202060102 | 824 | 824 | 986 | 863 | 8 |
| 10120202060103 | 503 | 503 | 563 | 437 | 0 |
| 10120202060104 | 420 | 420 | 482 | 454 | 0 |
| 10120202060105 | 287 | 429 | 429 | 363 | 44 |
| 10120202060106 | 704 | 704 | 705 | 485 | 0 |
| 10120202060202 | 0 | 0 | 0 | 0 | 0 |
| 10120202070101 | 19 | 19 | 19 | 0 | 0 |
| TOTAL ACRES | 9037 | 9895 | 11254 | 7669 | 2960 |

Table 25 summarizes existing road densities and how road densities will change for each action alternative. Numbers in the “Overall Road Densities By Alternative” reflect the road densities that would result from the construction and decommissioning of roads under each alternative. The road densities within riparian zones and within 300 ft of streams, for each of the action alternatives, have been calculated in the same way.

Soils in Table 25, designated as MVHEP, are defined as those having moderate to very high erosion potential, once they have been disturbed.

Table 25 Summary of Existing and Alternative Road Densities

| <i>Watershed #</i> | <i>Miles of Proposed New Road</i> | <i>Miles of Proposed Decom Road</i> | <i>Existing Overall Road Density</i> | <i>Overall Road Density By Ale</i> | <i>Existing Total # of Miles of Road on Soils With MVHEP By Alt</i> | <i># Of New Miles of Proposed Road on Soils With MVHEP By Alt</i> | <i>Existing FS Road Density W/in 300 ft of Streams</i> | <i>FS Road Density W/in 300 ft of Streams By Alt</i> | <i>Existing FS Road Density W/in Riparian</i> | <i>Road Density W/in Riparian By Alt</i> |
|----------------------|-----------------------------------|-------------------------------------|--------------------------------------|------------------------------------|---|---|--|--|---|--|
| Alternative 1 | | | | | | | | | | |
| 10120111020102 | 0 | 0 | 3.5 | 3.5 | 32.4 | 0 | 4.7 | 4.7 | 4.1 | 4.1 |
| 10120111020103 | 0 | 0 | 3.6 | 3.6 | 33.9 | 0 | 4.1 | 4.1 | 6.3 | 6.3 |
| 10120111020104 | 0 | 0 | 3.4 | 3.4 | 19.7 | 0 | 2.2 | 2.2 | 2.1 | 2.1 |
| 10120111020301 | 0 | 0 | 9.7 | 9.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10120111020305 | 0 | 0 | 3.7 | 3.7 | 4.2 | 0 | 4.2 | 4.2 | 6.8 | 6.8 |
| 10120202020105 | 0 | 0 | 2.7 | 2.7 | 17.5 | 0 | 3.8 | 3.8 | 5.5 | 5.5 |
| 10120202060102 | 0 | 0 | 3.7 | 3.7 | 34.3 | 0 | 6.6 | 6.6 | 6.3 | 6.3 |
| 10120202060103 | 0 | 0 | 4.6 | 4.6 | 32.1 | 0 | 6.4 | 6.4 | 12.6 | 12.6 |
| 10120202060104 | 0 | 0 | 2.2 | 2.2 | 14.6 | 0 | 3.1 | 3.1 | 4.2 | 4.2 |
| 10120202060105 | 0 | 0 | 4.7 | 4.7 | 10.6 | 0 | 3.4 | 3.4 | 3.8 | 3.8 |
| 10120202060106 | 0 | 0 | 2.4 | 2.4 | 16.4 | 0 | 3.4 | 3.4 | 5.6 | 5.6 |
| 10120202060202 | 0 | 0 | 4.5 | 4.5 | 3.0 | 0 | 6.9 | 6.9 | 4.9 | 4.9 |
| 10120202070101 | 0 | 0 | 0.6 | 0.6 | 0.3 | 0 | 0.2 | 0.2 | 0 | 0 |
| Alternative 2 | | | | | | | | | | |
| 10120111020102 | 4.0 | 10.8 | 3.5 | 3.0 | 32.4 | 2.7 | 4.7 | 4.0 | 4.1 | 2.7 |
| 10120111020103 | 1 | 6.3 | 3.6 | 3.2 | 33.9 | 0.6 | 4.1 | 3.6 | 6.3 | 5.5 |
| 10120111020104 | 0 | 10.6 | 3.4 | 2.21 | 19.7 | 0 | 2.2 | 1.0 | 2.1 | 1.1 |
| 10120111020301 | 0 | 0 | 9.7 | 9.71 | 0 | 0 | 0 | 0 | 0 | 6.8 |
| 10120111020305 | 0 | 2.8 | 3.7 | 2.6 | 4.2 | 0 | 4.2 | 3.8 | 6.8 | 0 |
| 10120202020105 | 5.4 | 1.9 | 2.7 | 3.1 | 17.5 | 5.4 | 3.8 | 3.8 | 5.5 | 4.5 |
| 10120202060102 | 2.2 | 8.4 | 3.7 | 3.2 | 34.3 | 2.2 | 6.6 | 5.4 | 6.3 | 5.1 |
| 10120202060103 | 0.7 | 13.4 | 4.6 | 3.3 | 32.1 | 0.6 | 6.4 | 3.9 | 12.6 | 8.0 |
| 10120202060104 | 1.7 | 3.1 | 2.2 | 2.1 | 14.6 | 1.3 | 3.1 | 3.2 | 4.2 | 4.5 |
| 10120202060105 | 0.5 | 1.9 | 4.7 | 4.5 | 10.6 | 0.4 | 3.4 | 3.6 | 3.8 | 3.7 |
| 10120202060106 | 0.7 | 1.0 | 2.4 | 2.4 | 16.4 | 0.7 | 3.4 | 3.3 | 5.6 | 5.3 |
| 10120202060202 | 0 | 0.5 | 4.5 | 4.1 | 3.0 | 0 | 6.9 | 6.2 | 4.9 | 4.8 |
| 10120202070101 | 0 | 0 | 0.6 | 0.6 | 0.3 | 0 | 0.2 | 0.2 | 0 | 0 |
| Alternative 3 | | | | | | | | | | |
| 10120111020102 | 2.4 | 10.8 | 3.5 | 2.9 | 32.4 | 1.9 | 4.7 | 3.9 | 4.1 | 2.7 |
| 10120111020103 | 0.6 | 6.3 | 3.6 | 3.1 | 33.9 | 0.4 | 4.1 | 3.2 | 6.3 | 5.3 |
| 10120111020104 | 0.9 | 10.8 | 3.4 | 2.5 | 19.7 | 0.8 | 2.2 | 1.0 | 2.1 | 1.1 |
| 10120111020301 | 0 | 0 | 9.7 | 9.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10120111020305 | 0 | 2.8 | 3.7 | 2.3 | 4.2 | 0 | 4.2 | 3.4 | 6.8 | 4.7 |
| 10120202020105 | 3.4 | 1.7 | 2.7 | 2.9 | 17.5 | 3.4 | 3.8 | 3.7 | 5.5 | 4.5 |
| 10120202060102 | 1.3 | 8.7 | 3.7 | 3.2 | 34.3 | 1.2 | 6.6 | 5.2 | 6.3 | 4.8 |
| 10120202060103 | 1.1 | 13.4 | 4.6 | 3.3 | 32.1 | 1.0 | 6.4 | 3.8 | 12.6 | 7.9 |
| 10120202060104 | 0.7 | 4.1 | 2.2 | 2.0 | 14.6 | 0.6 | 3.1 | 3.0 | 4.2 | 4.2 |
| 10120202060105 | 0.4 | 1.8 | 4.7 | 4.4 | 10.6 | 0.4 | 3.4 | 3.6 | 3.8 | 3.7 |
| 10120202060106 | 0.7 | 1.0 | 2.4 | 2.4 | 16.4 | 0.7 | 3.4 | 3.3 | 5.6 | 5.3 |
| 10120202060202 | 0 | 0.6 | 4.5 | 3.8 | 3.0 | 0 | 6.9 | 5.9 | 4.9 | 4.8 |
| 10120202070101 | 0 | 0 | 0.6 | 0.6 | 0.3 | 0 | 0.2 | 0.2 | 0 | 0 |
| Alternative 4 | | | | | | | | | | |
| 10120111020102 | 4.0 | 10.9 | 3.5 | 3.0 | 32.4 | 2.7 | 4.7 | 3.9 | 4.1 | 3.2 |
| 10120111020103 | 1 | 6.4 | 3.6 | 3.1 | 33.9 | 0.6 | 4.1 | 3.6 | 6.3 | 5.5 |
| 10120111020104 | 0 | 7.8 | 3.4 | 2.5 | 19.7 | 0 | 2.2 | 1.1 | 2.1 | 1.2 |
| 10120111020301 | 0 | 0 | 9.7 | 9.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10120111020305 | 0 | 2.9 | 3.7 | 2.5 | 4.2 | 0 | 4.2 | 3.6 | 6.8 | 6.8 |
| 10120202020105 | 5.4 | 1.2 | 2.7 | 3.2 | 17.5 | 5.4 | 3.8 | 3.7 | 5.5 | 4.6 |
| 10120202060102 | 2.2 | 7.9 | 3.7 | 3.2 | 34.3 | 2.2 | 6.6 | 5.3 | 6.3 | 5.2 |
| 10120202060103 | 0.7 | 12.5 | 4.6 | 3.3 | 32.1 | 0.6 | 6.4 | 4.0 | 12.6 | 8.2 |

| <i>Watershed #</i> | Miles of Proposed New Road | Miles of Proposed Decom Road | Existing Overall Road Density | Overall Road Density By Alt | Existing Total # of Miles of Road on Soils With MVHEP By Alt | # Of New Miles of Proposed Road on Soils With MVHEP By Alt | Existing FS Road Density W/in 300 ft of Streams By Alt | FS Road Density W/in 300 ft of Streams By Alt | Existing FS Road Density W/in Riparian | Road Density W/in Riparian By Alt |
|--------------------|----------------------------|------------------------------|-------------------------------|-----------------------------|--|--|--|---|--|-----------------------------------|
| 10120202060104 | 1.7 | 3.1 | 2.2 | 2.1 | 14.6 | 1.3 | 3.1 | 3.2 | 4.2 | 4.9 |
| 10120202060105 | 0.5 | 2.0 | 4.7 | 4.4 | 10.6 | 0.4 | 3.4 | 3.5 | 3.8 | 3.7 |
| 10120202060106 | 0.7 | 0.6 | 2.4 | 2.4 | 16.4 | 0.7 | 3.4 | 3.4 | 5.6 | 5.6 |
| 10120202060202 | | 0.6 | 4.5 | 4.0 | 3.0 | 0 | 6.9 | 6.2 | 4.9 | 4.9 |
| 10120202070101 | | 0 | 0.6 | 0.6 | 0.3 | 0 | 0.2 | 0.2 | 0 | 0 |

Erosion rates discussed in each alternative were calculated using the Water Erosion Prediction Project (WEPP) computer program. WEPP was used to estimate the effects of soil erosion and sediment generation for each alternative. The model was run using climate data for 40 years and the predicted yearly erosion rates were averaged. The model incorporates input of five elements: climate, soil texture, local topography, residual plant community and residual surface cover to derive erosion estimates. The accuracy of predicted erosion numbers is highly variable as well as being very dependant on precipitation. The greatest utility of the model is that it allows comparison between alternatives (<http://forest.moscowfsl.wsu.edu/fswepp/docs/distweppdoc.html>). Tables summarizing the range of slopes, soil types, and conditions for which the model was run as well as the assumptions used in the modeling process are located in Section C.1.1 of the Project File.

Table 26 compiles the estimated sediment numbers derived from using WEPP. The resultant values are shown in Tons Per Year (T/Y), Tons Per Project (T/P), and Avg. Tons Per Year (Avg. T/Y). Existing Conditions values represent estimated erosion associated with natural conditions, past, and current activities. The values associated with T/P values reflect the amount of potential sediment that could be eroded, by alternative and watershed, associated with the project. Average T/Y values are based on the assumption that all activities associated with this project will occur over a period of at least three years.

Table 26 Summary of Potential Erosion Rates

| <i>Watershed Number</i> | Grizzly Gulch Fire 2003 Estimates Tons/1 st year | Grizzly Gulch Fire 2004 Estimates Tons/2 nd year | <i>(Baseline) (T/Y)</i> | Alt 1 Existing Conditions Avg T/Y | Alt 2 SUM (T/P) | Alt 2 Avg T/Y (over 3 Year Period) | Alt 3 SUM (T/P) | Alt 3 Avg T/Y (over 3 Year Period) | Alt 4 SUM (T/P) | Alt 4 Avg T/Y (over 3 Year Period) |
|-------------------------|---|---|-------------------------|-----------------------------------|-----------------|------------------------------------|-----------------|------------------------------------|-----------------|------------------------------------|
| 10120111020102 | 9,364 | 2,341 | 799 | 3,140 | 1,094 | 365 | 2,171 | 724 | 2,778 | 926 |
| 10120111020103 | 17,529 | 4,382 | 807 | 5,189 | 636 | 212 | 1,282 | 759 | 1,282 | 427 |
| 10120111020104 | 50,720 | 12,690 | 690 | 13,381 | 974 | 325 | 4,091 | 768 | 4,091 | 1364 |
| 10120111020301 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10120111020305 | 0 | 0 | 153 | 153 | 48 | 16 | 204 | 62 | 204 | 68 |
| 10120202020105 | 0 | 0 | 690 | 690 | 1,016 | 339 | 1,175 | 322 | 1,175 | 392 |
| 10120202060102 | 0 | 0 | 849 | 849 | 542 | 181 | 600 | 693 | 600 | 200 |
| 10120202060103 | 0 | 0 | 618 | 618 | 263 | 88 | 263 | 356 | 263 | 88 |

| | | | | | | | | | | |
|----------------|---|---|-------|-------|-----|-----|-----|-----|-----|-----|
| 10120202060104 | 0 | 0 | 1,000 | 1,000 | 237 | 79 | 237 | 74 | 237 | 79 |
| 10120202060105 | 0 | 0 | 367 | 367 | 99 | 33 | 168 | 72 | 168 | 56 |
| 10120202060106 | 0 | 0 | 587 | 587 | 350 | 117 | 365 | 481 | 365 | 122 |
| 10120202060202 | 0 | 0 | 69 | 69 | 0 | 0 | 4 | 20 | 4 | 1 |
| 10120202070101 | 0 | 0 | 208 | 208 | 0 | 0 | 0 | 73 | 0 | 0 |

Watersheds highlighted in light gray are entirely within the project area.

In subsequent discussions of possible environmental consequences references are made to Best Management Practices (BMP's). The Forest Service is required by law to comply with the Clean Water Act and to implement BMP's in association with land management activities (Fryxell, 2003, Specialists report, Section C1.1 Project File). BMP's are techniques used to prevent or reduce non-point pollution to levels compatible with water quality Goals (Black Hills NF Plan, 1996, Appendix D-1). These practices are approved by the State and the Environmental Protection Agency.

Soil Erosion, Compaction, Heating, and Nutrient Loss

Alternative 1:

Under this No Action Alternative, current management plans would continue to guide management of the project area. No commercial or non-commercial treatments would occur as proposed under this project. However, timber sales currently in progress would continue. Effects from these ongoing activities are not expected to be significant due to the implementation of Forest Standard and Guidelines for soils, Region 2 Water Conservation Practices, and South Dakota Best Management Practices, Updated.

Current logging practices disturb less than 15% of a harvest area and compaction is expected in the area of landings and primary skid trails leading away from landing (White Paper, 1998). With the application of forest standards and guidelines, South Dakota forestry BMP's and practices from the WCPHB compaction is expected to be within acceptable limits (Reyher, 2003, Personal Communication).

Estimates of existing erosion rates for forested stands, for watersheds located entirely within the project area range from 618 T/Y to 5,189 T/Y. This is equal to 0.1 to 0.7 tons per acre (Table 26, Existing Conditions). The high erosion rate of 5,189 T/Y reflects the effects of the Grizzly Gulch fire in watershed 10120111020102.

However, if a large wildfire did occur and burned throughout a watershed, WEPP modeling estimates that potential erosion rates would increase to 5 to 23 tons per acre depending on slope and soils types (See Project File, Section C.1.1). Watersheds 10120111020102 and 10120111020103 have the largest number of acres of soil with moderate to very high erosion potentials, once they are disturbed, and would most likely have the largest increases in erosion associated with fire activity (Table 24). Since no timber harvest or fuels reduction is proposed under this alternative, the risk of a catastrophic fire will only increase over time. As a result, Alternative 1 has the most risk for increased erosion, nutrient loss, soil heating and the development of hydrophobic soils, compared to the other three alternatives.

Existing erosion rates reflect natural conditions and influences from recent and ongoing timbers sales as well as the Grizzly Gulch fire. Erosion rates and rates of nutrient loss in the areas burned during the Grizzly Gulch fire will likely decrease as the area recovers, and is supported by estimates of potential erosion rates (Table 26). Under Alternative 1,

erosion associated with roads would continue, and may worsen without effective closure and decommissioning of system and non-system roads. Without additional activity on the ground, soil productivity and nutrients for the area may increase over time.

Alternatives 2, 3, and 4:

Direct effects to soil erosion, compaction, heating and nutrient loss will be a reflection of numerous factors. Among these are the number of acres of soils involved with mass movement potential and moderate to very high erosion potential, the types of treatment type proposed on these soils, the miles of proposed and decommissioned roads, the amount of prescribed burning, and the number of acres where whole tree harvesting is used.

Alternative 3 has the highest potential for associated erosion issues and Alternative 2 has the least. This potential is reflected in the estimated potential rates summarized in Table 26. These higher potential rates reflect the amount of prescribed burning proposed, the number of soil acres proposed for treatment that involve moderate to very high erosion potential (once they have been disturbed) as well as some mass movement potential. There are 15.1 miles of new road proposed for construction on these soils.

Alternative 4 has the highest potential for ground disturbance, compaction, and nutrient loss compared to Alternatives 2 and 3. Alternative 4 proposes to involve the largest number acres for commercial thinning, which will be logged using whole tree harvest. The FEIS notes that whole tree skidding has the greatest potential for impact to a soil's organic matter over a large area (FEIS, 1996). However, remaining vegetation and litter-fall will help offset the loss of nutrients. In addition, soils in the northern Black Hills contain higher amounts of organic matter, compared to the southern Black Hills (Natvig, 2003, Personal Communication).

Although compaction is expected in the areas of landings and skid trails, current logging practices have been documented to disturb less than 10 % in a given land unit (White Paper, 1998). In evaluating potential compaction effects for Alternatives 2, 3 and 4, an estimate of 1 landing per 15 acres of harvest was used along with an estimate of skid trails covering 5-6% of a unit (Natvig, Pers. Comm., 2003). Analysis indicated that for each of the action alternatives that 7.1-7.2% of the acreage involved in commercial thinning would be impacted by landings and skid trails. This percentage is well below the 15% or less disturbance required by Standard 1103. In addition it should be noted that existing skid trails and landings will be used wherever possible to further reduce soil disturbance and compaction.

All three action alternatives propose the use of prescribed burning to some degree. Alternative 4 proposes to use prescribed burning on nearly 5,000 acres either as the sole prescription or in conjunction with another, such as fuel breaks or commercial thinning. Alternative 2 proposes only 339 acres (Table 24). Heating effects on soils will be less under Alternative 2, compared to Alternatives 3 or 4, because of the acreage amounts involved. However, most of the prescribed burning is broadcast burns, which burn at lower temperatures and should not detrimentally affect soil textures or nutrients (Lewis, 2003, Personal communication). Burning the large slash piles associated with whole tree

yarding will occur. Some affects due to heating will develop, as these piles burn much hotter. However they will occur on landings, which will minimize nutrient loss within the harvest areas.

Mass Movement

Alternative 1:

The project area encompasses 60,371 acres. Of that total acreage, approximately 53,224 acres (88% of the project area) consists of soils with some mass movement potential as defined by the Lawrence and Meade County Soil Surveys (NRCS, 1979, 1978; Table 12, 24). The Lawrence County Soil survey notes that for Vanocker-Citadel and Citadel soils, old landslides were present but not observed during soil mapping. Wet seepy areas were also identified as potential areas of mass movement. The survey noted the potential for landslides for Hisega, Grizzly Virkula, Maitland, and Vanocker with Rock Outcrop soils, but did not observe them during mapping.

District personnel have not observed landslides or other types of mass movement. Under Alternative 1, no commercial or non-commercial harvest would occur and no additional roads would be built. As a result, it is expected that any additional mass movement events would be scarce if there are not catastrophic fires. However, if a large and intense fire did occur, it is very likely that there would be mass movement events given that 88% of the soils within the project area have moderate to very high erosion potential once they are disturbed.

Alternatives 2, 3, and 4:

Landslides and other types of mass movement have the highest chance of happening when timber harvest and road building occurs on soils with some mass movement potential (Table 12, Table 13, Table 14 and Table 15). With the occurrence of mass movement, soils with potential for erosion are more susceptible, once they have been disturbed. It is important to note although NRCS states that the potential for soil erosion is moderate to very high for the soils referred to in (Table 12, Table 13, Table 14 and Table 15). They emphasize that this potential is applicable once the soils have been disturbed.

Alternative 4 proposes timber harvest and road construction activities on the largest acreages of soils with some mass movement potential and soils with moderate to very high erosion potential, once they have been disturbed. Alternatives 3 and 2 follow Alternative 4 in the number of acres involved for mass movement potential and potentially erosive soils. Alternatives 4 and 2 propose 15.1 miles of new road on soils with potential erodible soils while Alternative 3 proposes 11.5 miles of new construction on these same soils.

Landslides are not expected to occur within the planning area due to the scarcity of natural landslide features. However, in order not to accelerate natural mass movement activities, South Dakota BMP's for road location, design, construction, surface drainage, and maintenance would be implemented to reduce any potential for road failures for the soils listed in Table 13 and Table 15.

In addition, slope stability analyses will be conducted on all Citadel soils located on slopes greater than 30% and for all other soils on slopes greater than 55%. These stability analyses will be conducted where road building is planned or where timber harvest removes most or all of the canopy (Forest Plan, 1997, Std 1108).

Stream Flow Regime

Alternative 1:

Alternative 1 proposes no additional timber harvest activities. There are current legislative and other sales that are planned or on-going. Since existing sales are not expected to result in any significant changes to water yield, and if there was no catastrophic fire, flow volumes would be a function of existing vegetation structures and variations in climate. As vegetation increases over time, water yield may actually decrease. Due to the increased chance of catastrophic fire, there is increased potential for decreased infiltration capacity due to the development of water resistant, or hydrophobic soils. This could lead to increases in overland flow during runoff events, as well as increased surface erosion and stream sediment (FEIS, 1996, pg. III-55).

As roads would not be decommissioned under this alternative, the current road system would continue to function as an extension of the area's drainage system. Any associated increases in the amount of water and sediment delivered to the drainage network from existing roads would continue, along with any elevations in peak flow and acceleration in the timing of flows.

Alternatives 2, 3, and 4:

Under this proposed project, changes in water yield would primarily be a function of changes in stand and vegetation density and road density. However, any changes in flow volumes may not be reflected as changes in surface flow due to the underlying karst topography (see geology section).

Changes in stand and vegetation density result in changes to the amount of water lost due to interception, evaporation of snow and evapotranspiration. The Forest Plan indicates, on pages. III-45 and 46, that generally it is necessary to reduce the basal area of a forested watershed by 25% before there is a noticeable increase in stream flow. Roads influence water yield through soil compaction, reduction of percolation area, and by acting as conduits for transporting surface runoff into streams. Potential increases in stream flow are associated with possible increases in surface erosion and sedimentation in stream channels (FEIS, 1996, p. 111-45). Although it is known that these factors may affect flow volume, changes are very hard to measure, as numerous variables affect flow volume. Alternatives 2 and 3 propose to decommission 60.7 and 62.0 miles of road respectively. Alternative 4 proposes to decommission 55.9 miles of road. Reductions in overall road density, and within 300 ft of streams, due to decommissioning, are displayed by alternative and watershed in Table 25.

Region 2 guidelines direct that water yield is typically analyzed and discussed at the Forest level. However, a very general analysis as conducted to evaluate potential water

yield changes, due to the projects size and levels of treatment proposed to implement the projects purpose and need. Analysis of the 13 7th level HUC's, within the project area, indicated that no significant change to water yield is expected, due to timber harvest activities. As a result, no significant change to existing annual or peak flows, in any of the watersheds under Alternatives 2, 3, or 4 is expected (Mabey, 2003). The majority of the roads being decommissioned are non-system roads, which are typically two-track type roads, which are often vegetated with grasses and similar vegetation. Due to these road characteristics, little change in flow is expected due to decommissioning

Water Quality

The principal water quality issue related to the proposed project is sediment. Table 27 summarizes potential sediment sources within 300 ft of streams. The potential sediment values summarized below were derived from the amount of potential sediment erosion that would reach the base of timber harvest units. The estimates were derived using the WEPP model. To determine potential sediment sources that could be available for transport to streams, GIS analysis intersected unit boundaries with a 300 ft buffer around streams throughout the project area. These numbers yielded Tons per Project (T/P) for all the watersheds under each alternative. Tons Per Year (T/Y) was derived by assuming that the project will be conducted over a 3 year period and dividing the Tons per Project number by three. The alternative average maximum value was based on those units whose boundaries either touch or are within the 300 ft buffer. The alternative average minimum values were generated using the number of acres of proposed units within the 300 ft buffer.

Table 27 Summary of Potential Sediment Sources within 300 ft of Streams

| <i>Watershed Number</i> | Alt 1 Avg T/Y (over 3 Year Period) Maximum | Alt 1 Avg T/Y (over 3 Year Period) Minimum | Alt 2 Avg T/Y (over 3 Year Period) Maximum | Alt 2 Avg T/Y (over 3 Year Period) Minimum | Alt 3 Avg T/Y (over 3 Year Period) Maximum | Alt 3 Avg T/Y (over 3 Year Period) Minimum | Alt 4 Avg T/Y (over 3 Year Period) Maximum | Alt 4 Avg T/Y (over 3 Year Period) Minimum |
|-------------------------|--|--|--|--|--|--|--|--|
| 10120111020102 | 1,161 | 289 | 295 | 109 | 497 | 165 | 651 | 232 |
| 10120111020103 | 741 | 282 | 192 | 82 | 531 | 172 | 326 | 155 |
| 10120111020104 | 4,183 | 322 | 300 | 106 | 613 | 241 | 1095 | 485 |
| 10120111020301 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10120111020305 | 139 | 69 | 12 | 5 | 47 | 15 | 47 | 18 |
| 10120202020105 | 633 | 243 | 129 | 40 | 224 | 85 | 160 | 91 |
| 10120202060102 | 770 | 322 | 119 | 44 | 513 | 235 | 135 | 58 |
| 10120202060103 | 563 | 255 | 73 | 49 | 267 | 108 | 73 | 51 |
| 10120202060104 | 940 | 397 | 73 | 45 | 71 | 43 | 73 | 45 |
| 10120202060105 | 350 | 147 | 30 | 16 | 45 | 15 | 45 | 19 |
| 10120202060106 | 508 | 216 | 92 | 45 | 363 | 116 | 96 | 52 |
| 10120202060202 | 54 | 22 | 0 | 0 | 11 | 7 | 0 | 0 |
| 10120202070101 | 194 | 88 | 0 | 0 | 56 | 38 | 0 | 0 |
| TOTALS | 10,136 | 2,655 | 1314 | 541 | 3238 | 1239 | 2701 | 1205 |

Alternative 1:

Existing roads would continue to supply sediment to the area's drainage network where connected CDA's exists (Project File, Section C.1.1). Under this alternative, no new roads or skid trails would be built and no new potential sources of sediment would be created. Current water quality conditions would continue for analytes such as dissolved oxygen, temperature, pH, and total suspended solids.

However, if a catastrophic fire occurred, the potential and likely increases in erosion would most likely result in water quality degradation for temperature, total suspended solids, conductivity, and nitrates. Increased sediment input would also impact macro-invertebrate populations and fisheries habitat.

Alternatives 2, 3, and 4:

As stated above, sediment is the primary issue related to the proposed management activities for water quality. Potential supplies of sediment are a function of the number of miles of roads and the predominant surface type within 300 ft of streams, the amounts of road proposed for decommissioning and construction, and the amount of prescribed burning proposed for that alternative and the access of that material to the stream.

For all three action Alternatives, the proposed decommissioning of roads reduces road densities within 300 ft of streams and in riparian zones, except for watersheds 10120202060104 and 105. Road density increases only by 0.1-0.2 mile, which is not significant. Any sediment originating from these naturally surfaced roads should decrease over the long term.

Alternative 3 has the largest amount of potential sediment within 300 ft of streams. Alternative 3's larger potential sediment sources could influence water quality. The larger potential sediment sources are due to a combination of a larger amount of proposed commercial thinning, prescribed burning, and fuel breaks (Table 24, Table 25, and Table 27). Table 27 (immediately above) indicates that Alternative 3 has the highest average maximum for sediment, estimated to be 531 T/Y, with an average minimum of 45 T/Y. Alternative 4 is next and Alternative 2, the Modified Proposed Action, would have the smallest potential sediment sources within 300 ft of streams, with a range from 109 T/Y to 16 T/Y.

The greatest potential threat to water quality develops under the scenario of a large wildfire. In that case, potential sediment volumes within 300 feet of streams increase dramatically. WEPP modeling estimates that potential sediment volume, within 300 feet of streams, would range from 312 T/Y to 25,529 T/Y for the first year after a fire. These estimates are based on correlations with the Grizzly Gulch fire. The same slopes and soil type for this area were used in modeling for the effects of a 10,000 acre fire. Glen Lewis, project Fuels Specialist, estimated that there is a 28% probability that a fire of 10,000 acres within the project area will occur within the next 10 years.

Sediment volumes escalate due to increased runoff increasing erosion and the development of hydrophobic or water resistant soils. Mass movement events are common after large fires, which also increase the volume of sediment being eroded. Such large influxes of sediment into the system would degrade water quality, including dissolved oxygen, and aquatic habitat as a result of increased total suspended solids, total dissolved solids and turbidity. MacDonald, 1991, indicates that there is only a weak correlation between temperature increases and sediment. As a result, sediment related increases in temperature are unlikely.

Bear Butte, Boulder, Two Bit, Park, Vanocker, and Meadow Creeks all have designated uses for coldwater marginal fish life propagation, limited contact recreation, wildlife/stock watering, and irrigation. Alkali Creek, in addition to these designations, has a designated use of domestic water supply, although water is not currently being withdrawn for domestic use. Deadman Gulch, although it does not have a state designated reach with assigned beneficial uses, functions as the primary source of drinking water for the Ft. Meade Veterans Association.

Under Alternatives 2 and 4, Alkali Creek would experience no change to existing potential sources of sediment within 300 ft of streams (Table 27, Alt 1). Under Alternative 3, existing potential sediment sources could increase by up to 56 T/Y. However, only 17% of the watershed is within the project area. With the application of BMP's, no impacts to water quality are expected. In watershed 10120202060102, which includes the Deadman Gulch Area, the largest potential sediment source increase within 300 ft of streams would occur under Alternative 3 and the smallest would occur under Alternative 2 (Table 27). Road densities within 300 ft of streams are reduced the most under Alternative 4 for Deadman Gulch. Densities remain essentially unchanged for Alkali Creek under all action alternatives. Proposed harvest within 300 ft of Whitewood Creek is minimal. Alternative 4 has 80 acres within 300 ft, Alternative 2 72 acres, and Alternative 3 has 71. The low amount of proposed acreage for harvest, along with the application of BMP's and any mitigation measures regarding Deadman Gulch, will protect the reach from further impairment.

Sites where activities have the potential to contribute to erosion will be stabilized and maintained with erosion control measures in accordance with Forest Plan Standards, BMP's and the WCPHB. Site-specific mitigation measures will be designed to reduce effects to soils and water quality (See Appendix B). With the application of these BMP's and mitigation measures, no significant impacts to water quality are expected.

Channel Morphology

Alternative 1:

Alternative 1 does not propose any timber harvest, road building or decommissioning. As a result, there would be no effects to stream morphology. Current influences to drainage systems would continue. Stream channels that are presently unstable would continue to contribute influences to the drainage network until they stabilize. Existing roads and associated CDA's, and stream crossings, will continue their present influences

on channel morphology (Project File, Section D). With no road decommissioning there would be no reduction in the amount of water delivered to drainages via existing roads. Peak flows and their timing will remain at their present levels and occurrences. However, if a large and intense fire occurred, sediment sources available to channels may be increased due to vegetation loss, possible development of hydrophobic soils, and increased runoff.

Alternatives 2, 3, and 4:

As no significant changes in flow volume, or timing of flows are expected, flow related changes to channel morphology are not anticipated for Alternative 2, 3, or 4 (See Stream Flow Section).

Changes in channel morphology can also be related to increased sediment loading. Alternative 3 would generate the largest increase in potential sediment sources within 300 ft of streams, from existing conditions, while Alternative 2 would generate the smallest increase (Table 27). Alternative 3 would add only five additional stream crossings compared to Alternatives 2 and 4, which both add nine stream crossings. Existing locations of Connected Disturbed Areas (CDA's) located on system roads within 300 ft of streams are summarized in the Hydrology Report located in Section C.1.1 of the Project file. Such CDA's are defined as areas contributing sediment and water from disturbed areas that access a water body (Ohlander, 1998). Removal of CDA-related sediment sources would provide watershed improvement opportunities. Eliminating road related sediment sources would reduce excessive sediment loading. Sediment loading would be reduced by eliminating vehicle use that creates ruts and potholes and other types of road damage. This reduction would improve channel morphology over the long term and reduce the potential for sediment related water quality exceedances.

Additional opportunities for watershed improvement projects are defined in Table AQ 9.1 of the hydrology roads analysis report, which can be found in Section D of the Project File. All of these roads could either benefit from relocation, improvement of existing drainage measures, or improvement of riparian vegetation. Implementation of such watershed improvements would provide improvement by reducing sedimentation, improving local water quality, floodplain function, and riparian zone health.

Floodplains

Alternative 1:

Existing impacts to floodplains will continue. As this alternative proposes no additional vegetation management or road building, no new impacts to floodplains would occur. No existing system or non-system roads located on floodplains would be decommissioned.

However, if a large and intense fire did occur, changes in the floodplain associated with increased water yield and sediment loads are likely.

Alternatives 2, 3, and 4:

Alternative 3 proposes portions of 66 units totaling approximately 111 acres within the floodplain and Alternatives 2 and 4 propose portions of 70 units, encompassing approximately 112 acres.

Fuel breaks are the predominant treatment type proposed within floodplains for all action alternatives. The fuel breaks would parallel the roads and adjacent streams. Whole tree harvesting and skidding will be used to construct the breaks. Soils within the floodplain are influenced by water and would be susceptible to disturbance, erosion and compaction. Erosion occurring within floodplains has a higher probability of contributing sediment to the associated stream. Alternative 2 would generate the smallest increase over existing conditions (Table 27). Alternative 3 has the highest potential for contributing additional sediment in addition to existing conditions compared to Alternatives 2 and 4, which is a reflection of the number of acres involved in prescribed burning.

Alternatives 2 and 4 propose 0.4 miles of construction within the riparian zone while alternative 3 proposes only 0.1 miles. All three alternatives propose approximately 4.5 miles of decommissioning in the riparian zone. As a result, implementation of the action alternatives would improve floodplain function and condition compared to existing conditions.

Since increased erosion could impact floodplain function and conditions, numerous mitigation measures have been prescribed, which have been determined to be effective in controlling erosion (See Site Specific Mitigation Measures; USDA Forest Service, 1996, State of South Dakota, updated). As a result, it is expected that there will be no significant impacts to existing floodplain conditions.

No modification of floodplain function and condition, based on significant changes in flow are expected (see Stream Flow section).

Riparian Zones and Wetlands

The term, “wetlands” is generic, referring to areas that are not totally terrestrial or fully aquatic.

Wetlands classification is based on the source type of the water for the area and includes precipitation, ground water and surface water dominated systems. Surface water dominated wetlands are referred to as riparian systems (<http://h20sparc.wq.ncsu.edu/info/wetlands/types3.html>).

Alternative 1:

There will be no new impacts to riparian ecosystems under this alternative. Existing impacts resulting from roads, past harvest activities, and grazing would persist. Existing road densities within riparian zones is summarized in Table 25.

Alternatives 2, 3 and 4:

Harvest within riparian zones can produce localized soil compaction, erosion and introduction of sediment into the riparian zone, affect surface and groundwater relationships, and modify floodplain function (FEIS, 1996, Fryxell, 2003). The highest potential for adverse impacts to involved riparian zones would be where there is the greatest amount of surface disturbance from whole tree harvesting and road development (FEIS, 1996, Natvig, 2003, Personal communication).

Approximately 2.8 acres of Fish and Wildlife defined wetlands are involved in proposed treatments for all three action alternatives. The units with involved wetlands are listed in Section C.1.1 of the Project File. For all but two units, the amounts are less than 0.5 acres. These units are 0814060034 and 0814440048, which contain 0.71 and 1.6 acres of wetlands respectively.

Current impacts to wetlands due to existing roads would continue as none of them are proposed for decommissioning (Fryxell, 2003). Effects due to sedimentation and disturbance associated harvest are expected to be minimized through the application of BMP's and Forestwide Standard and Guides for Soil, Water, and Riparian zones.

Existing riparian road densities will be reduced in all action alternatives. Alternative 3 will decommission 4.7 miles of road within the riparian and construct only 0.12 miles compared to Alternatives 2 and 4 which propose to decommission and construct essentially the same number of miles of road (4.5/0.4 and 4.4/0.4 respectively). Short-term impacts due to sedimentation and disturbance of vegetation may occur as decommissioning and restoration activities occur. However, over the long term, riparian health is expected to improve as vegetation is reestablished and sedimentation associated with restoration activities declines.

All three action alternatives propose to involve approximately 106 acres of riparian habitat contained in portions of proposed units with 5 or more acres of riparian vegetation. Alternative 3 contains units with the largest amounts of riparian habitat associated with individual units. See Section C.1.1 of the Project File for proposed treatment units with wetlands components and riparian components.

Shaded fuel breaks involve timber harvest within the riparian zone. As discussed in the Vegetation section of Chapter 3, overstory trees will be removed to 15-20 ft spacing with understory conifers removed and surface fuels intensively managed or removed. Fuel breaks will be developed using whole tree harvesting. Whole tree harvest activities have the largest potential for impacts for erosion, disturbance of the soils organic layer, and nutrient removal. Removal of understory conifers could contribute to impacting habitat, large woody debris supply, and thermal modification when within 100 ft or less of perennial streams (FEIS, 1996).

The development of mitigation measures, in addition to the application of South Dakota BMP's for timber harvest, streams side management and site preparation, will be the key to achieving improved forest health and meeting required Forest Standard and Guidelines for soil, water, and riparian zone health. Such site specific measures could include harvest in the winter when the ground is frozen, conduct no commercial thinning within the streamside management zone (as defined in BMP IIIB1), or do group harvest selections where large trees are within the SMZ, and can still provide shading and large woody debris. Selective harvest could also be used to enhance the growth of hardwoods, especially within 100 ft of perennial streams, to supply vegetation for food, and large woody debris (Lewis, 2003, Personal communication).

Cumulative Effects

Cumulative effects include effects from past or present activities, activities that have been approved but not implemented, proposed activities within the project area and associated watersheds, and for this project, the larger cumulative effects area.

Cumulative effects under Alternative 1 include baseline conditions, discussed under direct and indirect effects, ongoing timber sales, and legislated treatments (Table 28).

Table 28 summarizes the acres of vegetation treatments from ongoing timber sales and legislated actions within both the project area and analysis area by 7th field watershed or HUC. The letter beside the watershed number denotes whether the watershed is I (inside project area), O (outside project area), P (partially inside project area), and I (watershed is outside the project area but hydrologically connected at the 6th field watershed or HUC level).

Table 28 Summary of Ongoing Timber sales and Legislated Actions

| For analysis area HUC7 | Ongoing timber sales and commercial legislated units | | | Noncommercial legislated units Acres treated outside project |
|---------------------------|--|---------------------------------|----------------------------------|---|
| | Total Acres commercial treatments | Acres treated inside project | Acres treated outside project | |
| 10120111010103 O | 286 | 0 | 286 | |
| 10120111010204 O | 892 | 0 | 892 | |
| 10120111010301 O | 312 | 0 | 312 | |
| 10120111020102 I | 1241 | 1241 | 0 | |
| 10120111020103 P | 2011 | 1575 | 436 | |
| 10120111020104 P | 195 | 195 | 0 | |
| 10120111020105 * | 1948 | 0 | 1948 | |
| 10120111020201 O | 2265 | 0 | 2265 | |
| 10120111020301 P | 342 | 0 | 342 | 191 |
| 10120111020305 P | 704 | 239 | 465 | 670 |
| 101202020105 P | 527 | 527 | 0 | |
| 10120202060102 I | 403 | 403 | 0 | |
| 10120202060103 I | 189 | 189 | 0 | |
| 10120202060104 I | 257 | 257 | 0 | |
| 10120202060105 P | 347 | 347 | 0 | |

| | | | | | |
|----------------|---|--------------|-------------|-------------|------------|
| 10120202060106 | P | 959 | 819 | 140 | |
| 10120202060202 | P | 231 | 231 | 0 | |
| 10120202070101 | P | 518 | 358 | 160 | |
| total | | 13626 | 6382 | 7245 | 861 |

Cumulative Effects inside the Project Area

Under Alternative 1 approximately 6382 acres of vegetative treatments in 12 watersheds would occur in the project area within the next few years (Table 28). This is less than 11% of the project area (Table 28).

While a total of 60,371 acres are within the project area, these acres are in many different watersheds, meaning the streams within the project area do not flow into a common stream within the project area. The thirteen 7th field HUCs in the project area belong to six 6th field HUCs, four 5th fields and two 4th fields (Table 29). The watersheds highlighted in light gray are watersheds located completely within the project boundary. The northern part of the project area flows into the Lower Belle Fourche River (4th field) and the southern part of the project area flows into the Middle Cheyenne River-Elk (4th field). This is important because project related effects are dispersed over a very large area.

Table 29 Summary of Relationship between 6th and 7th Level HUC's and Percent of HUC7 Watersheds in the Project Area

| HUC6 | HUC7 | 7 th field Watershed acres in project area | Total 7th field watershed acres | %watershed in project area |
|--------------|----------------|---|---------------------------------|----------------------------|
| 101201110201 | 10120111020102 | 7932 | 7932 | 100 |
| 101201110201 | 10120111020103 | 7368 | 8332 | 88 |
| 101201110201 | 10120111020104 | 5840 | 8692 | 67 |
| 101201110203 | 10120111020301 | 26 | 5608 | <1 |
| 101201110203 | 10120111020305 | 1415 | 7839 | 18 |
| 101202020201 | 10120202020105 | 5856 | 8360 | 70 |
| 101202020601 | 10120202060102 | 7350 | 7350 | 100 |
| 101202020601 | 10120202060103 | 5525 | 5524 | 100 |
| 101202020601 | 10120202060104 | 8965 | 8965 | 100 |
| 101202020601 | 10120202060105 | 3319 | 9049 | 37 |
| 101202020601 | 10120202060106 | 4799 | 7105 | 68 |
| 101202020602 | 10120202060202 | 689 | 11590 | 6 |
| 101202020701 | 10120202070101 | 1290 | 7587 | 17 |

Soil Erosion, Compaction, Heating, and Nutrient Loss

Numerous factors will affect erosion and natural rates of erosion are highly variable. Natural factors include geology, topography, and vegetation. Natural disturbances such as wildfires, large rainfall, or rain on snow events, can also lead to higher erosion rates.

Surface erosion in managed forestlands can accelerate due to roads, timber harvest and prescribed burning. Grazing, mining, and off-road recreation can also affect erosion rates. Best management practices are designed and implemented to limit any increased potential for erosion from planned activities.

Alternative 1:

There would be no increase in erosion due to increased harvest activities or controlled burns associated with this project. Roads densities would remain the same and no additional decommissioning would occur. Any road related erosion would continue as would accelerate erosion from the Grizzly Gulch fire. Over time, the area affected by the Grizzly Gulch Fire would revegetate and the erosion rate would decrease. Mining activities would continue at present levels. Cattle grazing would continue at approximately the present level. Increased population growth would lead to increased recreational use of the forest and the dispersed impacts from these activities (camping, hunting, OHV use etc). There may be a short-term increase in erosion from ongoing timber sales and legislated treatments.

The proposed fuel reduction associated with this project would not occur. This could increase the risk of accelerated soil erosion under Alternative 1 due to wildfire. Modeling and analysis of past fire events indicates that there is a 28% probability of a fire of 10,000 acres within the project area in the next ten years (G. Lewis, Pers. Comm., 2003). The WEPP model estimated accelerated erosion of 77,655 tons/year for the Grizzly Gulch fire within the Elk Bug Project area. Assuming similar slope and soil types, erosion from a 10,000-acre fire estimated at 123,536 tons/year the first year after a fire. Soil heating from a high intensity wildfire can create a hydrophobic layer in the soil that lowers infiltration and increases erosion. A large fire would also lead to a great loss of productivity and loss of nutrients due to volatilization of nitrogen, burning the organic soil layer, as well as from soil erosion associated with the fire.

Soil heating would occur only where piles of vegetation are burned. These small areas dispersed throughout the project area are insignificant from a cumulative effects perspective. Skid trails from past entries would be reused, limiting the amount of additional compaction. Minor nutrient loss would occur from harvest. Due to the small percentage of the watersheds being treated under Alternative 1, as well as the reuse of old skid trails, cumulative effects for compaction and nutrient loss would be minimal. There are approximately 15,605 acres of private land and land in other ownership scattered throughout the project area. There is no data available to accurately predict the amount and type of treatments that will be accomplished on non-Forest Service lands. Concerned land owner's, within the project area, and other agencies indicated during the scoping process that they are actively pursuing treatment options to reduce the spread on mountain pine beetles and the potential threat of catastrophic fire events.

Alternatives 2, 3, and 4

The WEPP model used to produce this table does not take into account BMPs or mitigations used to reduce impacts from land management activities. The table is most

useful to compare potential changes between the alternatives, not specific amounts of erosion.

Table 30 Summarizing the Increase in Potential Erosion from vegetation treatments by Alternative and Watershed

| HU6 | HUC7 | Baseline Tons/year | Alt1 Tons/year | Alt2 Tons/year | Alt3 Tons/year | Alt4 Tons/year |
|---------------------|------------------|-----------------------|-------------------|-------------------|-------------------|-------------------|
| | 10120111020102* | 3140 | 3348 | 3713 | 4071 | 4274 |
| | 10120111020103** | 5503 | 5503 | 5715 | 6262 | 5930 |
| | 10120111020104 | 13459 | 13459 | 13783 | 14227 | 14822 |
| 101201110201 | | 21710 | 22310 | 23211 | 24561 | 25027 |
| | 10120111020301 | 3 | 3 | 3 | 3 | 3 |
| | 10120111020305 | 153 | 186 | 202 | 248 | 254 |
| 101201110203 | | 156174 | 189 | 205 | 251 | 257 |
| | 10120202020105 | 690740 | 925 | 1263 | 1247 | 1316 |
| 101202020201 | | 690740 | 925 | 1263 | 1247 | 1316 |
| | 10120202060102* | 849 | 927 | 1108 | 1620 | 1127 |
| | 10120202060103* | 618 | 668 | 756 | 1025 | 756 |
| | 10120202060104* | 1000 | 1052 | 1131 | 1126 | 1131 |
| | 10120202060105 | 367 | 444 | 477 | 516 | 500 |
| | 10120202060106 | 587 | 817 | 934 | 1298 | 938 |
| 101202020601 | | 3421 | 3909 | 4406 | 5584 | 4453 |
| | 10120202060202 | 69 | 105 | 105 | 125 | 106 |
| 101202020602 | | 69 | 105 | 105 | 125 | 106 |
| | 10120202070101 | 208 | 328 | 328 | 401 | 328 |
| 101202020701 | | 208 | 328 | 328 | 401 | 328 |
| total | | 26253 | 27764 | 29517 | 32169 | 31486 |

*Watersheds are entirely within the project area.

*Watersheds are entirely within the project area.

Alternative 2 would have the smallest cumulative increase in potential erosion from vegetative treatments, while Alternative 3 has the largest, due to the larger number of acres proposed for harvest and prescribed burning. Alternative 4 has slightly less potential for increased erosion than Alternative 3.

For all action alternatives, more miles of roads are proposed for decommissioning than construction (Table 25). As a result, cumulative erosion from roads would decrease for all action alternatives, with Alternative 3 having the most positive effect and the least for Alternative 4. Additional information on existing road densities is summarized in Table

31 “Summary of Existing and Alternative Road Densities”. While there may be short-term increases in erosion from vegetative treatments, in the long-term cumulative effects will be reduced for all action alternatives by the large number of miles decommissioned.

Table 31 Summary of Roads Decommissioned and Built By Alternative

| Alternative | Road Miles Decommissioned | Road Miles Built | Net decrease |
|--------------------|----------------------------------|-------------------------|---------------------|
| Alternative 1 | 0 | 0 | 0 |
| Alternative 2 | 60.2 | 16.2 | 44 |
| Alternative 3 | 62 | 11.5 | 50.5 |
| Alternative 4 | 55.9 | 16.2 | 39.7 |

Controlled burns are burned at a cool temperature in the Black Hills and rarely burn through the duff to bare mineral soil (Glen Lewis, personal communication, 2003). This lowers the erosion potential and speeds the recovery process. The elevated erosion potential due to burning would last only two to three years before the watersheds returned to baseline conditions. Temporary roads and skid trails would be reseeded under BMPs, so the accelerated erosion associated with harvest activities is expected to recover within two years of seeding (John Natvig, personal communication, 2003). No cumulative effects are expected from soil heating from prescribed burning. Some heating will take place at large landings where whole tree yarding occurs but these will be small areas dispersed throughout the project area and would be insignificant from a cumulative effects perspective.

Under the frequent entry land management approach practiced on the Black Hills, residual compaction persists between entries on the main skid trails and landings. Cumulative effects from compaction would be minimized by reusing old skid trails and landings or harvesting soils prone to compaction when they are frozen, under snow, or dry. The cumulative nutrient loss from treatments is greatest for Alternative 3 due to the larger number of acres recommended for commercial harvest and prescribed burning. It is least for Alternative 2, which has the fewest acres recommended for commercial harvest or prescribed burning.

Mass movement

Alternative 1:

While some units to be treated in ongoing timber sales or through legislated actions will occur on soils prone to mass movement, most, if not all, of these units have been treated in the past and district personnel have not observed landslides or other types of mass movement. Under Alternative 1, any mass movement would be from conditions already in effect such as connected disturbed areas, or culverts that get blocked or washed away during a large storm event. No roads will be decommissioned under Alternative 1. There are presently 219 miles of roads on soils with some potential for mass movement. Wildfire would increase the potential for mass movement, as has been seen with the Grizzly Gulch Fire, in the Lead Deadwood area.

Alternatives 2, 3, and 4:

Older roads are often built in the drainages and have smaller culverts (or none) than roads built today. These older roads are more likely to cause slope failure than roads built under current practices. Therefore removing older roads will lower the risk of road caused slope failure. Table 32 lists the miles of road on soils prone to mass movement to be decommissioned or built under each alternative. Negative numbers show more construction than decommissioning.

Table 32 Cumulative Effect of Proposed Road Decommissioning or Construction on Soils with Mass Movement Potential

| HUC7 | Decommissioned | | | New Construction | | | Overall Decrease | | |
|------------------|----------------|-------|-------|------------------|-------|-------|------------------|-------|-------|
| | ALT2 | ALT3 | ALT4 | Alt2 | Alt3 | Alt4 | Alt2 | Alt3 | Alt4 |
| | miles | miles | miles | miles | miles | miles | miles | miles | miles |
| 10120111020102* | 5.5 | 5.5 | 5.5 | 2.7 | 1.9 | 2.7 | 3.6 | 2.8 | 1.9 |
| 10120111020103** | 5.5 | 5.5 | 5.5 | 1.0 | 0.6 | 1.0 | 4.9 | 4.5 | 0.6 |
| 10120111020104 | 8.4 | 8.4 | 5.7 | 0.0 | 0.8 | 0.0 | 7.6 | 8.4 | -1.9 |
| 10120111020305 | 0.6 | 0.6 | 0.6 | 0.0 | 0.0 | 0.0 | 0.6 | 0.6 | 0.0 |
| 10120202020105 | 1.9 | 1.6 | 1.1 | 5.4 | 3.4 | 5.4 | -1.6 | -3.8 | 2.6 |
| 10120202060102* | 8.3 | 8.5 | 7.8 | 2.2 | 1.2 | 2.2 | 7.1 | 6.3 | 0.7 |
| 10120202060103* | 12.3 | 12.3 | 11.4 | 0.6 | 1.0 | 0.6 | 11.3 | 11.7 | 0.1 |
| 10120202060104 * | 2.9 | 3.5 | 2.8 | 1.7 | 0.6 | 1.7 | 2.3 | 1.8 | 0.5 |
| 10120202060105 | 1.7 | 1.6 | 1.7 | 0.4 | 0.4 | 0.4 | 1.3 | 1.2 | 0.4 |
| 10120202060106 | 1.0 | 1.0 | 0.5 | 0.7 | 0.7 | 0.7 | 0.3 | 0.3 | 0.2 |
| 10120202060202 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.0 |
| 10120202070101 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 48.4 | 48.8 | 42.8 | 14.7 | 10.8 | 14.7 | 37.6 | 34.1 | 5.2 |

All the alternatives remove over 40 miles of roads on soils prone to mass movement, lowering the probability of a road induced mass movement. Alternative 2 has an overall decrease of 37.6 miles of road on soils prone to mass movement, with Alternative 3 showing an overall decrease of 34.1 miles. Both alternative 2 and 3 add more roads on these soils than they decommission for watershed 10120202020105. Alternative 4

decommissions fewer roads on these soils and has an overall decrease of 5.2 miles and an increase in watershed 10120111020103.

Table 24 shows the acres of treatment on soils prone to mass movement for each alternative. Most, if not all, of these units have been harvested in the past and district personnel have not observed landslides or other types of mass movement. Slope stability analyses will be conducted in areas of concern as stated in the direct and indirect effects. Given the slope stability analyses and South Dakota BMPs it is unlikely that any of the alternatives will lead to an increase in mass movement events.

Stream Flow Regime

Alternative 1:

The legislated activities are too dispersed to affect stream flow, therefore cumulative effects would be negligible. There would be no addition of sediment from project activities. In the watershed affected by the Grizzly Gulch Fire runoff will be higher than pre-fire conditions due to lack of interception of precipitation by vegetation, loss of cover, and hydrophobic soils. Most of the area will recover in 3 to 5 years, although it could take 10 years or longer on the severely burned areas (Grizzly Gulch Fire Watershed Analysis Report, 2002).

If a large high intensity fire occurs, there is potential for increased flow in the short-term until vegetation is reestablished.

Alternatives 2, 3, and 4:

It is necessary to reduce the basal area of a forested watershed by 25% before there is a noticeable increase in stream flow (FEIS, 1996). There are thirteen 7th field watersheds that flow into six 6th fields. Four 7th order HUC's would have cumulative harvest impacts from ongoing timber sales, legislated units and the proposed alternatives. HUC's 10120111020102, 03, 04, which are all in the same 6th field HUC, would have treatments above 25%, but water yield increases are expected to be less than four percent (Mabey, 2003). HUC 10120202060106 would also have treatment levels above 25%, but the geology of this watershed is not very susceptible to water yield increases (Mabey, 2003). The other watersheds do not have harvest levels that would have an appreciable effect on flow. Therefore, no appreciable cumulative effects are anticipated to stream flow.

Water Quality

Sediment delivered to streams is the most important water quality issue for management activities. Table 26 summarizes potential sediment rates within the project area.

Alternative 1:

The potential addition of sediment from the ongoing timber sales and legislated units is shown in Table 33 below. There would be no additional sediment from project activities. No roads would be decommissioned, roads with sediment problems would continue adding sediment to streams. Sediment from the Grizzly Gulch fire and roadwork along HWY 385 was contributing sediment to Bear Butte Creek, a fish-bearing stream, during a snowmelt runoff event springing the Spring of 2003 (S.Tangenberg, 2003, Pers. Comm). Runoff events would continue to contribute sediment to the stream until the area affected by the fire or road work are revegetated and stabilized.

Bear Butte and strawberry Creeks have reaches designated as impaired by the State, upstream of the project area. The designated reaches do not extend into the project area. Whitewood Creek has one reach designated as impaired within the project area, which extends from Spruce Gulch to Sandy Creek. All three streams were on the 305(b) and 303(d) lists for water quality criteria and Total Mean Daily Load (TMDL) requirements in 2002. Bear Butte Creek, from its headwaters to Strawberry Creek, only partially supported designated beneficial uses for flow and temperature and did not meet TMDL requirements for suspended solids. Strawberry Creek in 2002 did not meet criteria for cadmium, conductivity, copper, metals, salinity, Total Dissolved Solids (TDS), chlorides, and zinc. These exceedances are related to historical mining and subsequent treatments to remove metals from the water column. It did not meet TMDL requirements for cadmium, conductivity, copper and TDS. Whitewood creek did not meet criteria for pathogens, suspended solids, thermal modifications. TMDL's for fecal coliform, Total Suspended Solids (TSS) and temperature. No cumulative effects to water quality, including stream flow, temperature, TDS and TSS, are expected as no additional land management activities are proposed.

Alternatives 2,3 & 4 :

Table 33 gives a range of potential increases in sediment delivered to streams for each alternative due to harvest and prescribed burning. The model used to produce this table does not take BMP's or mitigations into account. The table is most useful to for making comparisons of potential change between alternatives. Alternative 1 is the baseline plus effects from ongoing timber sales and legislated actions. All action alternatives combine Alternative 1 with effects from the specific action alternative.

Table 33 Ranges in Potential Sediment Increases to Streams

| HUC7 | Baseline | Baseline | Alt1 | Alt1 | Alt2 | Alt2 | Alt3 | Alt3 | Alt4 | Alt4 |
|----------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| | Minimum tons/year | Maximum tons/year | Minimum tons/year | Maximum tons/year | Minimum tons/year | Maximum tons/year | Minimum tons/year | Maximum tons/year | Minimum tons/year | Maximum tons/year |
| 10120111020102 | 289 | 1061 | 417 | 1247 | 526 | 1541 | 582 | 1744 | 648 | 1897 |
| 10120111020103 | 284 | 741 | 457 | 935 | 539 | 1127 | 629 | 1466 | 612 | 1262 |
| 10120111020104 | 322 | 4183 | 366 | 4230 | 473 | 4530 | 608 | 4843 | 851 | 5325 |
| 10120111020301 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |

| | | | | | | | | | | |
|----------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|
| 10120111020305 | 69 | 139 | 98 | 167 | 103 | 178 | 113 | 213 | 116 | 213 |
| 10120202020105 | 243 | 633 | 561 | 848 | 601 | 977 | 646 | 1072 | 652 | 1008 |
| 10120202060102 | 322 | 770 | 395 | 833 | 439 | 952 | 630 | 1345 | 453 | 968 |
| 10120202060103 | 255 | 563 | 279 | 612 | 327 | 684 | 386 | 879 | 329 | 684 |
| 10120202060104 | 397 | 940 | 416 | 993 | 461 | 1066 | 459 | 1064 | 461 | 1066 |
| 10120202060105 | 147 | 350 | 259 | 422 | 275 | 452 | 274 | 467 | 278 | 467 |
| 10120202060106 | 216 | 508 | 469 | 723 | 514 | 815 | 585 | 1086 | 521 | 819 |
| 10120202060202 | 22 | 54 | 62 | 87 | 62 | 87 | 69 | 98 | 62 | 87 |
| 10120202070101 | 0 | 194 | 242 | 293 | 242 | 293 | 280 | 349 | 242 | 293 |
| total | 2655 | 10136 | 4021 | 11389 | 4562 | 12703 | 5260 | 14627 | 5226 | 14091 |

Alternative 3 has the highest potential increase and Alternative 2 shows the lowest potential increase for sediment available for delivery to streams. The increase in sediment is expected to last only two to three years after activities associated with the project end. As a result, any cumulative effects due to these increases in potential sediment delivery are expected to be short-term. Associated with these potential short-term increases in sediment delivery may be increases in sediment related water quality analytes, such as total suspended solids, total dissolved solids, turbidity, and dissolved oxygen. Increases in temperature are not expected due to the weak correlation between temperature and sediment (MacDonald, 1991).

However, many of the streams, both ephemeral and intermittent, within the project area are also vegetated. The vegetation will filter out much of the sediment delivered to these smaller streams higher in the system, before it has been transported downstream to larger systems

Bear Butte and Strawberry Creeks have reaches designated as impaired upstream of the project area and have EPA mandated TMDL requirements for fecal coliform, suspended solids, and temperature. Any increases in sediment related water quality analytes are expected to be minimal or within acceptable limits. This is the result of the requirement to implement and maintain road and timber harvest BMP's. For all action alternatives there is minimal harvest proposed along Whitewood Creek that is within 300 ft of the stream. Alternative 4 proposes 80 acres, Alternatives 2 and 3 are essentially the same at 72 and 71 acres respectively. With the implementation of BMP's and the minimal amount of acreage involved relative to the length of the designated reach with the project area, any increases in sediment related water quality analytes are expected not affect existing sediment loads. As a result, no change in cumulative effects is expected on this reach.

Roads are an important contributor of sediment to stream systems. Decommissioning will remove potential sediment sources and lower the connectivity between roads and streams. Table 25 gives road density by watershed for the different alternatives. Alternative 2 will decommission 21 roads within drainage bottoms, Alternative 3, 22 roads, and Alternative 4, 23 roads within drainages, lowering connectivity of roads and streams. Alternative 2 & 4 will build roads with a total of nine stream crossings, and alternative 3 will have five

new stream crossings. Road densities decrease under all three alternatives, leading to reduced cumulative effects from roads.

Approximately 10 miles of fuel breaks follow streams. Mitigation measures will be used to retain canopy for streams that require cool temperatures to meet designated beneficial uses (See Appendix B for mitigation measures).

Channel Morphology

Alternative 1:

Grazing would continue at approximately the current rate with the current impact on stream bank stability, no mining is planned for this area, but recreational use will increase over time. Additional recreation, particularly OHV's could have an impact to stream banks at water crossings.

No additional cumulative effects for Alternative 1 are expected. The ongoing timber sales and legislative actions will occur but BMPs, and mitigations should minimize the effects on channel morphology. The pulse of sediment from the Grizzly Gulch fire will work through the system over time. If a large wildfire occurred a large amount of sediment could be released and affect the channel morphology until the sediment worked through the system.

Alternatives 2, 3, and 4:

As stated in direct and indirect effects, no significant changes in flow volume, or timing of flows are expected, for Alternatives 2, 3, or 4. However, lower road densities and removal of roads within riparian buffers will decrease the rapid transport of runoff and sediment to channels from connectivity of roads and streams, lowering the cumulative effects from road, stream interaction.

Floodplains, Riparian Zones and Wetlands

Historically, water developments have occurred on private and forest service land, the primary purpose being to provide water for livestock. No additional grazing or development of springs is proposed under this project. Recent changes to grazing allotments within the project area include fencing projects, reductions in the season of use, and number of cattle on a given allotment. These changes have resulted in improved riparian conditions (Smith, 2003). There are numerous private in-holdings, located within the forest and proposed project area boundaries, which involve riparian habitat.

Historically, water developments have occurred on private and forest service land, the primary purpose being to provide water for livestock. No additional grazing or development of springs is proposed under this project and there are no current allotment EA proposals at this time. Recent changes to grazing allotments within the project area include fencing projects, reductions in the season of use, and number of cattle on a given allotment. These changes have resulted in improved riparian conditions (Smith, 2003).

There are numerous private-inholdings, located within the forest and proposed project area boundaries, which involve riparian habitat. Development of private in-holdings is expected to continue as populations increase. The type and magnitude of the impacts will be dependent on the type of development and how it's done. Possible activities leading to increased sedimentation and impacts to riparian/wetland and floodplain areas include construction, stream crossings, and timber harvest. These activities, combined with potential increase in riparian area recreation use could lead to increased sedimentation and short-term cumulative effects in riparian areas.

Development of private in-holdings is expected to continue as populations increase. The type and magnitude of the impacts will be dependent on the type of development and how it's done. Possible activities leading to increased sedimentation and impacts to riparian/wetland/ and floodplain areas include construction, stream crossings, and timber harvest. These activities, combined with potential increases in riparian area recreational use could lead to increased sedimentation and short term cumulative effects in riparian areas.

However, within the proposed project area, only 106 acres out of 3762 acres of riparian habitat are being proposed for treatment under all three action alternatives. Given this small amount of acreage, the requirement to implement of BMPs and mitigation, any increase in effects due to timber harvest (both treatment and legislated areas) is expected to be minimal. All of the action alternatives will have a beneficial reduction in long-term cumulative effects due to road closure (See Table 25). Alternative 3 shows the greatest decrease in road densities in these sensitive areas compared to Alternatives 2 and 4.

Alternative 1:

As the legislated treatments widely scattered over the project area there will be negligible impacts to floodplains, riparian zones or wetlands under this alternative. Roads currently affecting these areas will continue to do so. The three watersheds affected by the Grizzly Gulch fire will continue to have impacts from changes in flow and sediment regimes but will recover within a few years.

Alternatives 2, 3 and 4:

As stated in the direct and indirect effects floodplains, riparian zones and wetlands are susceptible to negative impacts from harvest, roads and fire. Application of BMPs are required to minimize impacts. Mitigation measures are required for these areas as discussed in direct and indirect effects.

Only 106 acres out of 3762 acres of riparian habitat within the project area are being treated in all alternatives. Given the small acreage, the use of BMPs and mitigation,

effects will be minimal. However, the cumulative effect of the sediment transported to these sensitive areas from proposed treatments, legislated treatments, and potential treatments on private land could lead to increased sedimentation in the short-term.

Table 25 summarizes alternative road densities within stream buffers and riparian areas. Alternative 3 shows the greatest decrease in road densities in these sensitive areas, but all action alternatives will have beneficial long-term cumulative effects. These long-term beneficial watershed effects are expected from maintenance and decommissioning of roads within these sensitive areas.

Cumulative Effects in the Analysis Area

Table 28 summarizes the number of acres proposed for treatment, for ongoing timber sales and legislated treatments, and the watersheds within which they occur.

Four watersheds within the analysis area are totally outside the project area and are not connected hydrologically at the 6th or 7th field HUC level (Table 29). These watersheds will have no cumulative effects to soil and water with this project. In Table 30, the six shaded watersheds are either partially within the project area and have vegetative treatments outside the project that contribute to cumulative effects, or are hydrologically connected at the 6th field level. Watershed 10120111020105 is located completely outside of the project boundary but is connected at the 6th field level. The approximately 1948 acres of commercial treatments in this watershed represents approximately 18.2% of the watershed. Given the fact that most of these units are located high in the watershed, sediment generated by land management activities should be filtered out by vegetation before the confluence with 7th field 1012011101020104, downstream from the project area. Cumulative effects would not be apparent at the 6th level HUC.

Of the watersheds located partially within the project area, 10120111020301 has only 26 acres within the project area. These watersheds will have no cumulative effects to soil and water quality and quantity with this project. The acres to be treated outside the project area, within this watershed, are primarily fuel breaks and noncommercial fuel reduction. Most of these treatments are along the margins of the watershed and will have minimal impact to streams, but is also connected downstream at the 6th field HUC level. As result, there will be no additional cumulative effects due to land management activities in this watershed.

Watersheds 20305, 20103, 60106, and 70101(full watershed number in Table 28) all have activities within the project boundary and have legislated activities both inside and outside of the project boundary. Watershed 20305 has both commercial and noncommercial legislated activities associated with timber sales and fuel treatments. Within this watershed, direct effects related to prescribed burning and the construction of associated dozer line, would contribute sediment to Forbes Gulch. In addition, there would be at least a 50% basal area reduction within constructed fuel breaks due to the high volume of dead and dying trees. Increased sediment contributions are expected to go beyond the normal two to three year recovery period. However, Forbes Creek flows away

from the project area. However, Forbes Gulch, which is an ephemeral and intermittent drainage, is not hydrologically connected to the other drainages within the project area. As a result, there may be associated increases in sediment related water quality analytes, when the drainage is carrying water. There are no stream reaches designated as impaired immediately downstream. As a result, the effects are not cumulative spatially with the project area, although they may be temporally.

Watersheds 20103, 60106, and 70101 involve 2,752 acres of ongoing timber sales and legislated activities within the project area and 736 acres outside the project area (Table 28). Streams associated with these activities flow into the project area. However, vegetation treatments, including commercial harvest, noncommercial thins, and prescribed burns, would happen over a three to five year period. As a result, post-treatment vegetation recovery would filter out increasing amounts of sediment, reducing potential sediment sources adjacent to streams. This overlapping process, in addition to the application of BMP's and watershed conservation practices, will help reduce any short-term impacts associated with sediment. Approximately 0.5 miles of commercial treatments occur along the uppermost reaches of Deadman Gulch, and occasionally parallel Forest Highway 26. Soils in this area have moderate to very high erosion potentials once they are disturbed. As a result, there most likely will be increases in potential sediment sources located in the upper portions of this watershed. These increases may be additive in time as well as spatially. This may result in a cumulative effect to sediment levels and is of concern due to the downstream beneficial use of drinking water at the Fort Meade VA hospital. To address these concerns mitigation measures are defined for this area under Appendix B.

Proposed treatments for commercial thinning and fuel breaks, in general, will be aiming for a 50% basal area reduction. Based on the modeling done for direct and indirect effects it is assumed that there will potentially be additional erosion and sediment available to streams. As timber harvest and vegetation recovery will overlap each other for several years, it is assumed that there could be short-term cumulative effects to erosion, sediment, and perhaps in some cases, water quality.

The cumulative effects of grazing, private development in riparian areas, and water developments was summarized under Cumulative Effects, Floodplains, Riparian Zones, and Wetlands. As no long term changes in cumulative effects are expected within the project area, the same conclusion is drawn for effects within the analysis area.

Transportation System

Affected Environment:

The existing transportation system was inventoried and reviewed in 2002. Timber to be accessed within the proposed sale areas will utilize existing transportation facilities with improvements and require construction and reconstruction.

Existing Condition:

Table 34 displays the types of roads and the jurisdiction of the roads for the project area.

Table 34 Existing Transportation System

| Type | Miles |
|------------------|-------|
| Federal Highway | 11.4 |
| County | 12.4 |
| Arterial | 0.0 |
| Collector | 8.7 |
| Local | 157.3 |
| SUB-TOTAL | 189.8 |
| Non-System Roads | 70.5 |
| TOTAL | 260.3 |
| Density | 3.4 |

Open/ Closed Roads

Table 35 displays the percentage of open and closed roads in the project area.

Table 35 Road Management

| Open Year Long | Open Seasonally | Closed Year long | Decommissioned |
|----------------|-----------------|------------------|----------------|
| 43% | 45% | 12% | 0% |

Non-System roads not needed for management or other uses will be obliterated or decommissioned as the opportunity arises. Road obliteration will consist of one or more of the following: Ripping, Seeding, Water barring, Slashing, Removal, or Blocking.

The area is considered open for travel except for areas with yearlong closures for wildlife and seasonal closures for soft roadbed conditions. At present there are a number of road closures located throughout the area. The current Road Management Objectives (RMOW) for the remaining system roads have no closures.

Rights-Of-Ways:

The Forest Service has no Rights-Of-Way for the following listed areas:

Table 36 No Forest Service Right-Of-Way

| Alternative No. | Road Number | Approximate Length | Legal Description |
|-----------------|-------------|--------------------|-------------------------|
| 2,3,4 | U030024 | 0.2 | T.5N., R.4E. Section 18 |
| 2,3,4 | U030025 | 1.0 | T.5N., R.4E. Section 18 |
| 2,3,4 | 5 | 0.2 | T.5N., R.4E. Section 17 |
| 2,4 | U080088 | 0.1 | T.4N., R.4E. Section 27 |
| 2,3,4 | U030031 | 0.1 | T.5N., R.4E. Section 4 |

Environmental Consequences:

Alternative 1

Alternative 1 'No Action': Will have no effect on the present condition because no additional roads will be constructed, reconstructed or decommissioned within the area. Existing roads that have "Best Management Practices" (BMP's) violations will be addressed during specified maintenance, as funding is available.

Action Alternatives 2, 3, and 4

Depending on the alternative, access to the proposed treatment areas will require approximately 34.5 to 42.5 miles of road construction or reconstruction, which will potentially have the following effects:

1. Improve vehicle access to the area.
2. Increase road maintenance needs and costs.

Table 37 Proposed Transportation Activities by Alternative

| Alternative | New Road Construction | Road Reconstruction | Decommission | Obliteration of New Road Construction |
|-------------|-----------------------|---------------------|--------------|---------------------------------------|
| 2 | 16.2 | 26.3 | 60.7 | 4 |
| 3 | 11.5 | 23.0 | 62.0 | 2.6 |
| 4 | 16.2 | 26.3 | 55.9 | 4 |

Roads that would be obliterated under Alternative 3 are: U030025, U030024, 4, 5, 6, 7, and 30. The same roads would be obliterated under alternatives 2 and 4 along with roads 8 and 9.

A more detailed listing of effects may be found in the environmental consequences sections in Chapter 3 for the various resources affected by the proposed transportation activities. Additional measures will be implemented to minimize impacts using "Engineering Design Guidelines" & "Best Management Practices."

Specific Concerns:

Some road locations will require a field review with the District Botanist to assure that sensitive plant habitat is not compromised. Refer to the mitigation section in Appendix B for the roads that the field review applies to.

Open / Closed / Road Densities by Alternatives:

Table 38 Road Density by Alternative in Miles/Square Mile

| Alternative | Open Y/Long | Open Seasonally | Closed Y/Long | Decommissioned |
|--------------------|--------------------|------------------------|----------------------|-----------------------|
| 1 | 1.5* | 1.5 | 0.4 | 0.0 |
| 2 | 1.1 | 1.2 | 0.5 | 0.8 |
| 3 | 1.1 | 1.2 | 0.5 | 0.8 |
| 4 | 1.1 | 1.3 | 0.5 | 0.7 |

*Density is measured as miles of road per square mile.

Table 39 Percentage of Open and Closed Roads by Alternative

| Alternative | Open Y/Long | Open Seasonally | Closed Y/Long | Decommissioned |
|--------------------|--------------------|------------------------|----------------------|-----------------------|
| 1 | 43% | 45% | 12% | 0% |
| 2 | 31% | 34% | 14% | 21% |
| 3 | 31% | 34% | 13% | 22% |
| 4 | 31% | 35% | 15% | 20% |

Additional Information:

Additional maps, calculations and data that were used in preparing this analysis are available in the project file at the Northern Hills Ranger District Office, 2014 North Main Street, Spearfish, SD 57783.

Fire Hazard and Fuel Loading

Affected Environment:

Introduction

Composition, structure, and arrangement of vegetation exert a major influence on frequency and intensity of wildfires. The Elk Bugs and Fuels project area includes five forest cover types: ponderosa pine, quaking aspen, white spruce, hardwoods other than aspen, and non-forest (e.g., grass, rock). Ponderosa pine is by far the most common cover type on the project area.

Stands range from pure ponderosa pine on drier sites to ponderosa pine mixed with spruce, aspen, paper birch, bur oak, and hophornbeam, also known as ironwood. Lower-elevation drainage bottoms are forested with hophornbeam and oak. Spruce, aspen, and paper birch are common in north-facing ponderosa pine stands. Much of the ponderosa pine cover type originated in the late 1800s or early 1900s after heavy logging, bug epidemics, and/or wildfires. Stands are predominately even-aged, with remnant over-mature trees that survived wildfires, insect infestations, and logging.

Snowstorms in the fall of 1998 and spring of 1999 caused considerable damage and mortality in some of the ponderosa pine stands in the northeastern Black Hills. Areas impacted by blowdown are highly variable in terms of size of the impacted area (Beaver Park Fire Management Plan). These areas have higher concentrations of both hazardous fuels (less than 3" in diameter) and large-diameter fuels (3" and greater).

The Beaver Park area and vicinity are currently experiencing a mountain pine beetle epidemic. The project area is adjacent to the north, west, and south sides of the Beaver Park Inventoried Roadless Area. Beetles have moved out of Beaver Park into surrounding forest lands. Locations such as Vanocker Canyon, Park Creek, and Elk Creek Canyon are becoming heavily infested. Beetle-caused mortality is occurring on National Forest System lands and those under other ownership.

Large tracts of trees killed by beetles can lead to large, stand-replacing fires. Crowns of trees (crown fuels) will ignite when the heat from a fire burning on the ground raises crown fuels to ignition temperature (Van Wagner 1977). Moisture must first be driven from a fuel before it can be ignited. Moisture in live fuels such as green needles is considered low at 80-90%, but fine dead fuels can reach moisture levels as low as 3-4%. Fuels with less moisture to evaporate means it will take less heat for a fire to ignite and spread through those fuels. Fire will spread faster and flame lengths will be higher. In addition, fires burning in areas of heavy downed fuels are more resistant to control because they release more energy (intensity) over longer periods of time and slow the construction of firelines (Agee et al. 1998).

Tree mortality due to beetles and storms has created, and continues to create, large amounts of dried fuels. These consist of both the fine fuels that are used to predict fire behavior and spread and the large-diameter fuels that can increase fire severity and resistance to control. The vertically oriented dried pine needles on recently bug-killed trees ignite much more readily than those on green trees. The problem is compounded by the tendency of beetles to attack dense stands, which can sustain active crown fire. Crown fires burn in tree canopy layer above the surface fuels. Hazard decreases after needles fall off beetle-killed trees, but the stand still contains large amounts of fuel that, when dry, will burn intensely and resist control due to increased heat production, spotting from snags, and significant reduction in fire line production. Large woody fuels have little influence on spread and intensity of the initiating fire, but they can contribute to development of large fires and high fire intensity. Fire persistence, resistance to control, and burnout time are significantly influenced by loading, size, and decay state of large woody fuel (Brown et al. 2001). Although decaying material may hold additional moisture at times, the contribution of decayed, broken-up large woody fuel to the energy release of a fire is considerably greater than the same material when sound (Brown et al. 2001). Assuming near-100% mortality in these areas, hand crews will not be effective in containing a fire after the dead trees fall.

Table 40 compares fuel loading and associated fire behavior for stands with heavy beetle caused mortality against stands that have not been attacked by beetles. The following elements are displayed in the table. Crown fraction burned refers to the amount of tree canopy consumed in a fire. Rate of spread (ROS) represents the speed at which the fire travels across the landscape. Perimeter growth rate is the increase in the total length of the outside edge of the burning area per hour. Fire area represents the size of the fire one hour after ignition. Spread distance is the forward rate of spread in one hour. Torching Index is the open (20-foot) wind speed at which crown fire activity begins in the specified fire environment. Torching Index is most useful as a comparison of the fuel “ladder” between surface fires and the canopy of the forest. Crowning Index is the open wind speed at which active crown fire is possible. The crowning index is useful to compare the capacity of stands to sustain a running crown fire.

According to the National Wildfire Coordination Group fireline handbook (1998), fire line production rates for dozers in heavy fuels such as these are approximately 25 to 50 percent, of what can be constructed in grass/pine litter types.

Table 40–Predicted fire behavior comparison in bug-killed trees with red needles attached, and after the dead trees have fallen.

| Project name: | Elk Bugs and Fuels | | |
|----------------------------------|---------------------------|-------------------|------------------------------|
| | Bug Killed Foliage | Green tree | Bug killed Heavy down |
| Surface fuel model | 9 | 9 | 13 |
| Type of fire | Active crown | Surface | Surface |
| Crown fraction burned | 100 | 0 | No crowns |
| Rate of spread | 9,966 ft /hr | 660 ft /hr | 1,452 ft/hr |
| Flame length | 74 ft. | 3 ft. | 12 ft. |
| Perimeter growth rate | 23,100 ft | 1782 ft | 3,630 ft |
| Fire area | 717 Ac | 5 Ac | 18 Ac |
| Spread distance | 9966 feet | 660 feet | 1452 feet |
| Potential crown fire ROS | 9966 ft/hr | 3662 ft/hr | No crowns |
| CROWN FIRE HAZARD INDICES | | | |
| Torching Index | 15 mph | 26 mph | No crowns |
| Crowning Index | 13 mph | 28 mph | No crowns |

The November 2000 Forest Service report “Protecting People and Sustaining Resources in Fire-adapted Ecosystems – A Cohesive Strategy” classifies fire-adapted ecosystems by *fire regime group* and *condition class*. These groups are useful for cataloging fire and ecological information and are part of the National Fire Plan policy to which fuels management projects are tied. The system is based upon the effects of fires on dominant

vegetation, from low to high severity, and recognizes the variability in fire that occurs within or between fires on a site (Agee 1993).

Fire Regime Descriptors

Table 41 describes five combinations of fire frequency (expressed as fire return interval) and fire severity. Fire Regime Groups I and II have fire return intervals of 0-35 years. Group I includes ponderosa pine, other long-needle pine species, and dry-site Douglas-fir. Group II includes the drier grassland types, tall-grass prairie, and some chaparral ecosystems. Groups III and IV have fire return intervals of 35-100+ years, and Group V is the long-interval (infrequent), stand replacement fire regime.

Table 41– The Five Historic Natural Fire Regime Groups.

| Fire Regime Group | Frequency (Fire Return Interval) | Severity |
|--------------------------|---|-----------------------------------|
| I | 0-35 years | Low severity |
| II | 0-35 years | Stand replacement severity |
| III | 35-100+ year | Mixed severity |
| IV | 35-100+ year | Stand replacement severity |
| V | >200 years | Stand replacement severity |

Fire Regime Groups I and II

These regimes occupy nearly all the lower elevation zones across the U.S. and are the groups most affected by human intervention. Analysis shows that these types demonstrate the most significant departure from historical conditions. The departures are largely a result of housing development, agriculture, livestock grazing, aggressive fire suppression, and logging. These areas are at greatest risk of loss of highly valued resources, commodity interests, and human health and safety. The ponderosa pine communities of the Black Hills are classic Fire Regime I.

Fire Regime Group III

Fires of different severities created a mosaic of stand structure, age, density, species composition, and fuel loading across the landscape. The mosaics tended to be more distinct as the fire effects are more pronounced in these fire regimes. Fires that burned in this fire regime created more diversity across the landscape, with patches created by mixes of mortality and unburned or underburned areas ranging in size from less than one acre to 25,000 acres. Aspen stands most often burn on a cycle somewhat similar to their

surrounding vegetation, although in the case of ponderosa pine, there were probably times when pine stands burned but aspen stands did not due to their more mesic nature. During drought periods and extreme wind events these aspen stands would burn, but with differing intensities from the surrounding vegetation. Stands of aspen and other deciduous trees within the project area are considered to be in Fire Regime III.

Current Condition Class Attributes

Condition Class is used to categorize the current condition with respect to each of the five historic Fire Regime Groups. The National Fire Plan strategy uses Condition Class descriptors to identify risk conditions. Current condition is defined in terms of departure from the historic fire regime (as determined by the number of missed fire return intervals) and resulting alterations to structure and composition of the system. Higher Condition Class values indicate greater risk of fire-caused losses of key system components.

Table 42 Condition Class Descriptions

| Condition Class ¹ descriptions | | |
|---|--|--|
| Condition Class | Fire Regime | Example Management Options |
| 1 | Fire regimes are within an historical range and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within an historical range. | Where appropriate, these areas can be maintained within the historical fire regime by treatments such as fire use. |
| 2 | Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range. | Where appropriate, these areas may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the historical fire regime. |
| 3 | Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range. | Where appropriate, these areas may need high levels of restoration treatments, such as hand or mechanical treatments, before fire can be used to restore the historical fire regime. |

¹Current conditions are a function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure.

Fires in Condition Class 1 are generally low-intensity, low-severity burns that leave the soil intact and functioning normally. These fires generally pose little risk and have positive effects on biodiversity, soil productivity, and water quality.

Condition Class 2 situations develop as one or more fire return intervals are missed, primarily due to well-intentioned suppression efforts, while understory vegetation continues to grow. If this accumulating vegetation is not treated, fires begin to burn more intensely, increasing difficulty of suppression. The impact of fires on biodiversity, soil productivity, and water quality become more pronounced.

In Condition Class 3, fires are relatively high risk. The forest is littered with considerable amounts of dead material and is choked with hundreds of small trees that reach into the crowns of the larger, older-age forest above. During drought years, small trees and other vegetation dry out and burn along with the dead material, fueling severe, high-intensity wildland fires. At these intensities, wildland fires kill all trees, even large ones that, at lower fire intensities, would normally survive. Condition Class 3 is classified as high risk because of the danger it poses to people and the severe, long-lasting impacts likely to result to species and watersheds when a fire burns, particularly in drought years.

The Black Hills ponderosa pine forest is recognized as classic Fire Regime I. There are many historic examples of relatively frequent, low-intensity fires and the resulting vegetative structure. Historically, a given acre of forest would have burned every 10 to 40 years (Black Hills National Forest Fire Management Plan 2002), with the shortest return intervals on the dryer pine sites. The Elk Bugs and Fuels project area is dominated by ponderosa pine sites, although stands of aspen, grass, and white spruce also exist. Other deciduous trees occur in small clumps or as an understory component in pine stands, but for purposes of fire regime type, the dominant covertype will be used.

Research by Shinneman and Baker (1997) proposes that large, stand-replacing fires were an integral part of the Black Hills ponderosa pine forest. Considerable information exists on fire history and ecology of ponderosa pine communities. The overwhelming body of evidence is that the frequency of fire in these areas was sufficient to control the fuels and vegetative structure in such a way that large, stand-replacing fires would be quite rare. Biswell et al. (1973) considered crown fires in ponderosa pine to be exceptionally rare. Even in low-severity fire regimes, however, intense fires may sometimes occur, possibly due to longer-than-normal fire return intervals that allow litter and understory fuels to build up, or due to very unusual fire weather (Agee 1993). Large blocks of even-aged stands are unusual in ponderosa pine forests, but do occur (Agee 1993).

It does appear that stand-replacing fires may have been an infrequent part of the fire regime in the Black Hills. In most instances however, frequent fire will act as a natural thinning agent (Wright and Bailey 1982) to keep fuel conditions from reaching a level where crown fires are likely. Surface fires helped kill the younger, weaker trees and dense thickets in young pine stands, minimizing competition and stand stagnation. Nutrients in the litter were recycled (Vlams et al. 1955, Moir 1966, Wollum and

Schubert 1975). Fire pruned the lower branches and thinned the foliage of remaining small trees (Biswell et al 1973). Repeated fires permitted the development of mature ponderosa pines with expanded canopies, sometimes nearly closed (Wright and Bailey 1982).

Other than the few fire history studies done in the Black Hills area, most historical data is qualitative rather than quantitative, presenting an opportunity for speculation. Early explorers noted an abundance of charred logs and snags, which they attributed to intense, stand-replacing fires. Based upon these observations, they concluded that crown fires were common, but Parrish et al. (1996) determined that these conclusions were suspect. Baker and Ehle (2001) propose that for regeneration of ponderosa pine to be successful, a fire-free interval of 50 years would be required. This theory is based upon the assumption that a fire in any season would kill almost all seedlings up to six feet tall. They also assume that in order to survive, a small tree must have experienced the necessary fire-free interval. They also point out that during a surface fire, however, not all areas within the perimeter will burn, although this is not defined spatially or in relation to fire size. Baker and Ehle acknowledge that even some of the small (less than six-foot) trees would have survived, which coincides with the theory that most ponderosa pine stands were multi-aged but often approximately the same size. They also assume that fires would not scar trees greater than 150 years old, although often times older trees have repeated scars.

Historical accounts appear to indicate that the Black Hills did not fit the description of typical pre-settlement ponderosa pine ecosystem in every way (Parrish et al. 1996). Shinneman and Baker propose that some ponderosa pine stands in the Black Hills were more dense than other, more typical ponderosa pine forests. Limited numbers of large patches of relatively dense stands may have been present in 1874, but such information about the Black Hills should be viewed cautiously because there was insufficient data to accurately determine stand densities (Parrish et al. 1996). Dense second-growth pine existing over a large, contiguous area of the Black Hills has only been recorded once, and was of a limited duration (about 100 years). No information is available to determine how often such large areas might escape disturbance or whether a 100-year gap in landscape-level mortality was normal (Parrish et al. 1996). While most attempts at classifying a ponderosa pine forest focus on what is “typical”, it probably rarely exists; various successional stages can be found in forests, as well as variations of the successional phases (Wright and Bailey 1982).

Brown and Sieg’s 1996 study of the Black Hills notes a reduction of fire scar dates at the end of the 19th century, which appears to be the result of Euro-American settlement activities. Post-settlement changes in ponderosa pine have been documented in numerous studies. These studies are not limited in geographic location but scattered throughout the western U.S. For instance, Gruell et al. (1982) in Montana, Weaver (1959) in Washington, Madany and West (1983), Stein (1988) in Utah, Laudenslayer et al. (1989) in California, and Barrett et al. (1980) and Steel et al. (1988) in Idaho all suggest that increased fuel loading, tree density, and crown fire occurrence are common results of fire exclusion in ponderosa pine communities.

While areas of dense trees may have existed, they would typically have been separated spatially. The coalescing of these patches since settlement into larger and larger areas capable of supporting very large crown fires represents a shift from low or moderate

intensity to high intensity (Covington and Moore 1992). Long fire-free intervals (40 years), although possible, would likely be rare due to the climate and prolific regeneration that provides relatively continuous fuels in the Black Hills. Fires occur every year in the Black Hills, even in wet years. Without suppression, these fires would burn for days or weeks. While spread rates may be low under wet conditions, the resulting spread over such long periods could result in large areas burned, but not necessarily at crown fire intensities. There is evidence that fire incidence in the Black Hills may have included both low- and moderate-intensity surface fires and stand-replacing fires (Shinneman and Baker 1997). While crown fires likely occurred historically in the Black Hills, they would have been quite rare compared to the more frequent, low-intensity burns that occurred on a frequent basis. Fire regimes are based upon dominant fire factors such as intensity, rate of spread, and severity. Therefore, ponderosa pine in the Black Hills should be classified as a short-return, low-intensity fire regime.

Fires of light intensity can leave sufficient organic matter on the ground surface so that the surface is protected. Severe fires such as crown fires will consume the duff and litter layer, kill much of the vegetation, and often create hydrophobic (water-repelling) soil conditions. These effects, the potential risks to developed property and values such as timber and recreation, and the possible threat to firefighter and public safety justify fuel treatment in fire regimes that typically had short-return, low-intensity fires. Condition Class is a useful attribute, but must be used carefully when applied to managed forests such as the Black Hills. Prior to 2002, recorded large fire activity in the project area was limited to the Lost Gulch fire in 1931 (400 acres), the Big Elk fire in 1949 (1,576 acres), the Deadwood fire in 1959 (4,547 acres), and the Pine fire in 1983 (132 acres). Only a small percentage of the Deadwood fire burned in the project area, but approximately 85 percent of the Big Elk fire burned in the project area. There have also been numerous small fires that were quickly extinguished by aggressive suppression tactics. Most of the stands within the analysis area have not experienced fire for a considerable length of time.

In 2002, two large fires burned in the vicinity of the project area. The Grizzly Gulch fire burned 11,589 acres in June and July. Almost half of the fire (5,608 acres) burned within the Elk Bugs and Fuels project boundary, including 3,025 acres of National Forest System lands and 2,583 acres in other ownership. National Forest System lands within the project area that burned were mostly forested with ponderosa pine, aspen, or aspen/birch cover type. Mortality of trees on National Forest System lands within the project area was mostly low to moderate, with high mortality on approximately 240 acres. In July, the Little Elk fire burned approximately 484 acres of private and National Forest System lands just southeast of the project area.

The Revised Forest Plan identifies fire hazard ratings at the stand level for conifers using a matrix of stand structure and slope. These ratings were compared to the parameters for Condition Class and were determined to be a logical fit given the available information. The translation from fire hazard to Condition Class can be made for a low severity, high frequency fire regime because the changes that occur in Condition Class for these systems are the result of changing fire hazard. This type of translation may not be appropriate for other regimes, such as low frequency, high severity regimes that do not have a significant component of surface fires.

For the purpose of this project, conifer stands that would be rated as high in hazard using the matrix in the Revised Forest Plan (20,599 acres) were assigned to Condition Class 3. Those with a medium hazard rating (11,925 acres) were assigned Condition Class 2, and those with a low hazard rating (9,413 acres) were assigned Condition Class 1. Deciduous stands are being encroached by conifers and are at the high end of Condition Class 2.

Hazard, Values and Risk

Fire Management Direction

The 1995 Federal Wildland Fire Management Policy identified guiding principals that are fundamental to wildland fire management. The first and most important guiding principal identifies firefighter and public safety as the top priority in every fire management activity. The Elk Bugs and Fuels project area lies within the Spearfish Canyon, Bethlehem, Elk Creek, and Custer Peak compartments of the Black Hills Workload and Prevention Workload analysis. Each compartment is rated individually for hazard, values, and risk. For the purposes of the analysis, *hazard* is defined as the fuels and topography of the area, *values* are natural or developed areas where loss or destruction by wildfire would be unacceptable, and *risks* are human uses that have the potential to result in a wildfire ignition.

The Spearfish compartment is rated as “high” in hazard, value and risk. The Custer Peak compartment is rated “high” in risk and value, and “moderate” in hazard. The Elk Creek compartment is rated “moderate” in risk, “high” in hazard and “moderate” in values. The Bethlehem compartment is rated “high” in risk and hazard and “moderate” in values. Once the risks, hazards and values are evaluated, it is possible to determine how vegetation management activities, or the lack thereof, affect the surrounding environment. The purpose of hazardous fuels reduction on the Black Hills National Forest is to reduce the intensity or heat of a wildfire and reduce fire spread rates.

Fire Hazard Assessment

Fire behavior is the manner in which a fire reacts to available fuels, weather, and topography. A change in any of these components results in a change in fire behavior (DeBano 1998). Fire behavior is complex, with many contributing factors in the categories of topography (slope, aspect, elevation), weather (climate, air temperature, wind, relative humidity, atmospheric stability) and fuels (size, type, moisture content, total loading, arrangement) (Agee 1993). These three elements comprise the fire environment, surrounding conditions, influences, and modifying forces that determine fire behavior (NWCG 1996).

Topography and weather at a given location are beyond the ability of management to control. Fuel hazard is the single most controllable factor. Weather conditions such as drought, high temperature, low humidity, and high wind play a major role in the spread of wildfires and are influenced by topography and location of mountains as well as global influences such as La Niña and El Niño (Baker 2003). Weather conditions are a major factor in the initiation and spread of all wildfires, but Omi and Martinson (2002) found that stands with prior fuel treatments experienced lower wildfire severity than untreated stands burning under the same weather and topographic conditions. Fuel management

modifies fire behavior, ameliorates fire effects, and reduces fire suppression costs and danger (DeBano 1998). Manipulating fuels reduces fire intensity and severity, allowing firefighters and land managers more control of wildland fires by modifying fire behavior in the fire environment (Pollet and Omi 1999).

Fuel management can include reducing the loading of available fuels, lowering fuel flammability, or isolating or breaking up large continuous bodies of fuels (DeBano 1998). Fuels contribute to the rate of spread of a fire, intensity/flame length, fire residence time, and the size of the burned area (Rothermel 1983, Agee et al. 2000). For these reasons, the comparison of alternatives in this analysis focuses on the reduction of important fuels, fire behavior indicators, and relative rating of fuel hazard within ½ mile of private property.

A wildfire hazard assessment should analyze the hazard of crown fires as well as surface fire. Crown fires normally are highly destructive, difficult to control, and present the greatest safety hazard to firefighters and the public. Therefore, fuel management must emphasize the factors that contribute to the initiation and spread of crown fires. These factors include height of the forest canopy above the ground, density of the canopy, stand density, and basal area (Omi and Martinson 2002). In general, crown fires burn hotter and result in more severe effects than surface fires. For example, rains following the 2002 Grizzly Gulch fire resulted in mudslides that entered the town of Deadwood. There are no known instances of a similar occurrence in the Black Hills due to surface fires. Historically speaking, a typical fire in ponderosa pine forests had little effect on the herbaceous component other than removing the cured material above the ground (Agee 1993). Crown fires generally spread at least two to four times faster than surface fires (Rothermel 1983). Fires that spread more quickly and with higher intensities pose a greater risk to firefighters and the public. Agee (1996) states that crown fire potential can be managed through prevention of the conditions that initiate crown fires and allow crown fires to spread. Three main factors contributing to crown fire behavior can be addressed through fuels management: initial surface fire behavior, canopy base height, and canopy bulk density.

Using methodology in the Revised Forest Plan FEIS, 46% of the project area's stands (20,599 acres) are rated as having high fuel hazard. Twenty-six percent, or 11,925 acres, are rated as medium hazard, and 28% (12,242 acres) of the project area is rated as having low fire hazard. In addition, there are 15,605 acres of other ownership in the project area.

Surface Fuels

Fire behavior is described by flame length, rate of spread, and fireline intensity (Rothermel 1983). Surface fuels are an important factor in determining how fast a surface fire will spread and how hot it will burn. Surface fuels consist of needles, leaves, grass, forbs, branches, logs, stumps, shrubs, and small trees. Surface fire factors are also important to the initiation and spread of crown fires.

Surface fuels in the project area range from low and moderate natural fuel loads of needles, grass, and woody ground fuels to isolated sites with heavy ground fuels consisting of tree tops broken off by snowstorms. Grass with some downed woody material is the dominant ground vegetation in most sites, with needlecast and common juniper mixed in throughout the project area. Surface fuel loading is generally fairly

light, ranging from two to three tons per acre in stands with mostly grass understory up to 10 tons per acre in areas with juniper and downed woody material. Areas with storm-damaged trees have additional fuel loads ranging from three to fifteen tons per acre on top of the preexisting natural fuels (Beaver Park Fire Management Plan). Fuel models found in the project area include 2 (grass), 9 (timber litter), 10 (litter and shrub), and 11 (slash and woody debris).

Potential fire behavior was modeled for existing vegetation and fuels using the weather parameters that represent the “average worst” conditions that can be expected on 90% of all the days that fires occur (“90th percentile” weather data). Historic weather data was gathered from the Nemo Remote Automated Weather Station (RAWS). Ninetieth percentile weather data is the normally accepted weather parameter used for fuels planning. The most extreme end of atmospheric and fuel moisture conditions, such as those that occurred during the Jasper fire in the southern Black Hills in 2000, are not normally used for fuel modeling. The following table displays 90th percentile weather data used for modeling for this project.

Table 43 Weather Conditions used for this Analysis

| | |
|--------------------------------|---------------------|
| Air Temperature | 85 degrees F |
| 1-hour fuel moisture | 4% |
| 10-hour fuel moisture | 6% |
| 100-hour fuel moisture | 13% |
| 1000-hour fuel moisture | 15% |
| Live fuel moisture | Cured |
| 20-foot wind speed | 15 mph |

At current fuel conditions and under the 90th percentile weather conditions, potential fire size may exceed the less-than-five-acre suppression objective for project areas in Management Areas 5.1 and 5.2A. Suppression objectives could be met for all other Management Areas in the project area when a surface fire occurs. The suppression objective would not be met in any part of the project area if a crown fire occurred. Fires in beetle-killed trees with red needles spread very rapidly, and would not be likely to be contained even with very aggressive suppression tactics.

**Table 44 Suppression Objectives by Management Area,
with Predicted Size of Fire in One Hour**

| Management Area | Acres | Suppression Objective | Surface Fire Size, 1 Hour | Crown Fire Size, 1 Hour | Beetle-killed Trees, Fire Size, 1 Hour |
|------------------------|--------------|------------------------------|----------------------------------|--------------------------------|---|
| 3.31 | 426 | <10 acres | 4 acres | 113 acres | 717 acres |
| 3.32 | 1,644 | <10 acres | 4 acres | 113 acres | 717 acres |
| 5.1 | 11,604 | <5 acres | 4 acres | 113 acres | 717 acres |
| 5.2A | 3,299 | <5 acres | 4 acres | 113 acres | 717 acres |
| 5.4 | 27,793 | <15 acres | 4 acres | 113 acres | 717 acres |

Canopy Fuels

Canopy Base Height (CBH) is the lowest height above the ground at which there is a sufficient amount of canopy fuel to propagate fire vertically into the canopy. CBH incorporates ladder fuels such as shrubs and understory trees as well as the lower branches of mature trees. It is often measured at the lowest height above ground where at least 30 pounds per acre per foot (or .010 kilograms per cubic meter) of available canopy fuels is present. The lower the canopy base height, the easier it is for a given surface fire to initiate a crown fire. Low canopy base heights provide the “ladder” which allows a surface fire to become a crown fire.

Canopy Bulk Density (CBD) is defined as the mass of available canopy fuel per unit canopy volume. It is a bulk property of a stand, not an individual tree, and is represented as the available canopy fuel load divided by canopy depth (Scott & Reinhard 2001). For any given species, more widely spaced trees have a lower canopy bulk density, which makes it more difficult to maintain crown fires.

In order for a crown fire to initiate, a surface fire must be intense enough to ignite the lowest level of branches that will propagate fire to the upper levels of the canopy. In order for the initiated crown fire to persist, the canopy must be dense enough for the fire to spread from one tree’s branches to another tree (CBD). Stands with high CBDs can sustain a crown fire that initiated outside the stand, even when surface fire intensity and CBH are such that fires that start within the stand itself will not transition into a crown fire.

Risk of Ignition

According to the Black Hills Wildfire Prevention Analysis, the Elk Bugs and Fuels project falls within compartments that are considered to have a high risk of ignition. The project area is located in Fire Management Zone 2 (FMZ 2). There have been a few relatively small fires in the project area in the last 20 years, but the Grizzly Gulch fire of 2002 burned approximately 11,000 acres and was immediately adjacent to and partially within the northwest portion of the project area. The fire caused evacuation of the towns of Lead, Deadwood, and Galena, as well as several outlying subdivisions. The conditions that allowed the Grizzly Gulch fire to spread rapidly through the crowns of the trees also exist in some parts of the project area. The conditions that allow a crown fire to occur include a relatively continuous conifer canopy, ladder fuels, steep topography and exposure to adverse weather conditions such as high winds, low humidity, and high temperatures.

Table 45 Fire Occurrence for FMZ 2

| FIRE MANAGEMENT ZONE 2 | |
|-------------------------------|---|
| Fire class/size | Average number of fires per year |
| A/0.25 acre | 20 |

| | |
|--------------------------|--------------|
| B/0.25-10 acres | 11 |
| C/11-100 acres | <1 |
| D/111-300 acres | <1 |
| E/300-1,000 acres | 0 |
| F/1,000 + acres | <1 |

PROBACRE Modeling

The software program PROBACRE was used to assess the probability of a major single wildfire event or multiple events and the long-term probability that a combination of fire events, both large and small, would result in a total burned area in excess of a particular number. All probabilities are calculated from information on annual frequency of fires by size class of concern.

PROBACRE INPUTS: PROBACRE predicts the number of acres that will be burned in the future, over a chose timeframe. This program assesses the risk of catastrophic consequences from a single or series of wildfire events and the long-term probability that a combination of these events would result in a total burned area in excess of a user-specified number. The program bases its probabilities on fire occurrence history. Fire frequency input is from the Black Hills N_F_M_A_S_ (NFMAS) historic fire table. The period of historical fire records is 1970 through 1996. Large fires from 2002 were added to reflect up-to-date information. Fire probabilities are based on the conditions that existed during the historical analysis period and represent a range of conditions. Those conditions, which include weather factors, may or may not be present for the projected time period. The PROBACRE analysis was conducted for Fire Management Zone 2 (FMZ 02), period length was 10 years.

Table 46 Fire Management Zone 2

| SIZE CLASS (acres) | FIRE FREQUENCY (fires per time period) | | PROBABILITY OF NUMBER OF FIRES PER PERIOD | | | | | |
|----------------------------|--|----------------------|---|------------|---------|---------|---------|----------|
| | ANNUAL | PERIOD (10 years) | No Fires | 1 Fire | 2 Fires | 3 Fires | 4 Fires | >4 Fires |
| 10 | 31 | 310 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 |
| 100 | .79 | 7.9 | .0004 | .0029 | .0116 | .0304 | .0601 | .8946 |
| 500 | .12 | 1.2 | .3011 | .3614 | .2169 | .0868 | .0260 | .0078 |
| 1,000 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3,000 | .030 | .30 | .7408 | .2222 | .0333 | .0033 | .0003 | 0.0 |
| 10,000 | .030 | .30 | .7408 | .2222 | .0333 | .0033 | .0003 | 0.0 |
| Probability of Exceeding → | 10 | -Acre Threshold in → | 10 | Years is → | 1.00000 | | | |
| Probability of Exceeding → | 100 | -Acre Threshold in → | 10 | Years is → | 1.00000 | | | |
| Probability of Exceeding → | 300 | -Acre Threshold in → | 10 | Years is → | 1.00000 | | | |

| | | | | | | | | |
|----------------------------|--------|----------------------|----|------------|---------|--|--|--|
| Probability of Exceeding → | 1,000 | -Acre Threshold in → | 10 | Years is → | 1.00000 | | | |
| Probability of Exceeding → | 5,000 | -Acre Threshold in → | 10 | Years is → | .5616 | | | |
| Probability of Exceeding → | 10,000 | -Acre Threshold in → | 10 | Years is → | .2813 | | | |

Values at Risk

Values help establish fuel treatment priorities. According to the Black Hills Fire Prevention Planning and Workload Analysis, the values at risk for this project include timber, water storage, scenic byways, residential development, fish and wildlife habitat, commercial development, visual resources, recreation, and cultural/historical concerns.

The report “Protecting People and Sustaining Resources in Fire-adapted Ecosystems: A Cohesive Strategy to Reduce Over-accumulated Vegetation”, approved on October 13, 2000, establishes the following priorities:

Wildland-urban interface. Wildland-urban interface areas include those areas where flammable wildland fuels are adjacent to homes and communities.

Readily accessible municipal watersheds. Water is a critical resource in many western states. Watersheds impacted by uncharacteristic wildfire effects are less resilient to disturbance and unable to recover as quickly as those that remain within the range of ecological conditions characteristic of the fire regime under which they developed.

Threatened and endangered species habitat. The extent of recent fires demonstrates that in fire-adapted ecosystems few areas are isolated from wildfire. Dwindling habitat for many threatened and endangered species will eventually be impacted by wildland fire. The severity and extent of fire could eventually push declining populations beyond recovery.

Maintenance of existing low risk Condition Class 1 areas. It is recognized that in many cases, it is easier to maintain sites in low hazard conditions than it is to restore sites that are a high hazard.

There are several **Communities at Risk** (Fed. Reg., Volume 66, No. 166, *Urban Wildland Interface Communities within the Vicinity of Federal Lands that are at High Risk from Wildfire*, August 17, 2001) within or adjacent to the project area. These communities include Boulder Canyon, Sturgis, Galena, Lead, and Deadwood. Wildland-urban interface areas are increasing in the project area. This expansion will continue as more and more private in-holdings are subdivided and developed. Currently in excess of 500 homes, outbuildings, and cabins exist within or directly adjacent to the project area. In addition, there are approximately 250 additional structures within one mile of the project boundary. Structures are scattered throughout the project area. Any project-level fire in the Elk Bugs and Fuels analysis area would require structure protection of at least some of the residences on any given day, depending on the direction of fire spread.

Managing Risk to Communities

Research by Jack Cohen (1999) has shown that structures with typical ignition characteristics (wood sided, wood framed, asphalt composition roof) are at risk of catching on fire from one of three sources. The first is direct exposure to intense flames from a nearby source, which could be intensely burning vegetation or another structure. His research shows that the structures may be at risk if the flame front is less than approximately 100 feet away. Structures may also be ignited by less intense sources against or close to the side of the structure. This can occur if firewood or other flammable material next to the structure is ignited by a ground fire or firebrands. In addition, firebrands falling directly on the roof can ignite the structure if the roof is flammable, or if flammable debris is present.

An important difference between the behavior of fires in urban areas and those in wildlands is that structures (homes, garages, and other buildings) are part of the fuel conditions. Research by Dr. Cohen and others has provided information on how structures catch on fire, and how once on fire they contribute to the spread of the wildfire. Once a structure ignites, the fire can spread to other nearby structures, sometimes without igniting the surrounding vegetation.

Fuel treatments around and within communities are performed to reduce fire hazard and thus reduce the potential damage to community resources and increase the safety of the public and of firefighters. Fires burning through a community can damage and destroy homes and other structures, and damage other public and private property, such as vehicles and urban trees and shrubs. The goals of wildland-urban interface treatments are to reduce flammability, fire intensity, and potential for firebrands and crown fires, and increase firefighter safety and effectiveness.

In order to effectively protect a community located in a high fire hazard environment, it is desirable to perform fuel treatment projects at a range of distances from homes. Treatments at some distance from the developed portion of a community (a few to several miles) can reduce the direct risk to the community when conditions that support the initiation and spread of crown fires that can reach the community are managed, or where a large or intense fire may cause indirect damage to the community (such as sedimentation of a water source).

Treatments near developed portions of a community (hundreds to thousands of feet from structures) can add to the protection of the community infrastructure and local environmental resources. They can increase the safety of escape routes for residents and access routes for firefighters. Reducing spotting potential and the production of firebrands from this zone can reduce the risk to structures, although spotting can occur over much longer distances when burning intensity is high. It is generally true, however, that the greater distance that a given point is from a fire, the less pronounced spot fires at that location become. If treatments are applied to create or link areas that could act as firebreaks, fires may be kept outside a community. For fires that might originate in or near these areas, treatments that are effective at reducing spread rates or decreasing resistance to control can increase the opportunity for containing the fire before it damages structures.

Treatment of natural fuels in and around developed areas is not sufficient to insure protection of neighborhoods and individual privately owned structures. Firebrands from crown fires may be carried long distances, and fires that start from firebrands in or immediately around homes can ignite structures. Construction details, materials used in

homes, removal of flammable material from and adjacent to the homes, and the treatment of vegetation on the property itself are important to individual structure protection. Ideally, each homeowner engages in this kind of protection for his or her home, including installation of inflammable roofs and other areas on which firebrands might collect and ignite flammable materials. It is still important, however, to have room in which firefighters can work safely from to protect the structure, since firefighter intervention is almost always needed during the passage of a wildland fire to suppress insipient ignitions (Scott 2002). There must be a large enough area for firefighters to work safely in; even with full wildland protective gear, radiant heat will injure a firefighter or homeowner before untreated wood siding ignites (Scott 2002, Butler and Cohen 1998).

Treatments that center on high value and strategic locations also make sense in managing fire spread across the landscape. Since treatment of every acre is improbable due to both ecologic and economic concerns, it is logical to concentrate the bulk of treatments in these locations.

There are two municipal watersheds within or near the project area – the Fort Meade Veterans Administration Hospital and City of Sturgis watersheds. Watersheds that are on non-public lands have received some vegetative treatments.

Desired Conditions

Vegetative Conditions and Indicators

The desired fuel conditions for the Elk Bugs and Fuels project area consist of well spaced trees without extensive ladder fuels in pine stands. Canopy base heights would be high enough that surface fires would not transition to crown fires at 90th percentile weather conditions. Canopy bulk density would be less than that required to sustain active crown fire spread under the same weather conditions.

Torching Index and *Crowning Index* are measurements used to indicate these conditions. Torching Index is the open (20-foot) wind speed at which crown fire activity begins in the specified fire environment. Torching Index is most useful as a comparison of the fuel “ladder” between surface fires and the canopy of the forest. Crowning Index is the open wind speed at which active crowning is possible. The crowning index is useful to compare the capacity of stands to sustain a running crown fire.

Openings such as meadows would be larger and more prevalent. Deciduous trees such as aspen and birch would occupy more area, serving as areas of less intense fire behavior under most conditions. Strategically located breaks in the fuel complex would increase opportunities to compartmentalize fires. Roads, trails and other access routes would be treated to provide areas of lower flammability in which fire suppression forces could conduct holding or burnout operations. These natural and constructed fuelbreaks would compliment area treatments to help suppression forces contain wildfires.

Fuelbreaks are often confused with firebreaks, which are narrower and cleared to bare mineral soil with no attempt at vegetation conversion. A fuelbreak is defined as a strategically located, wide block or strip on which the covering of dense, heavy or flammable vegetation has been permanently changed to one of lower fuel volume and reduced flammability (Green 1977). Removal of conifers from fuelbreaks can reduce the flammability of vegetation within the fuelbreak and encourage hardwood development.

Typically, hardwoods in the Black Hills are considered less flammable, and therefore overall flammability can be reduced while still providing for vertical development of vegetation. Some of the proposed fuelbreaks are located alongside and within riparian areas. Although riparian zones generally contain more moisture, fire has been found to be common in riparian areas (Olson 2000). In addition, Everett et al.(2001) found that though riparian fires may be fewer and more severe than those on adjacent sideslopes, a correlation between sideslope and riparian burns could still be determined. Under mild conditions, riparian areas may serve as a barrier to wildfire, but under more severe conditions they may burn intensely. Therefore, flammable fuels need to be reduced if riparian areas are to be part of pre-constructed fuelbreaks.

Fuelbreaks are not intended to stop the headlong rush of a fast-moving wildfire (Green 1977, Omi 1997). Some fires burn with such intensity and expand so quickly that burnout operations cannot safely be conducted before the fire reaches the site. This is why fuelbreaks need to be used in conjunction with vegetative treatments (Omi 1997). Fuelbreaks are used to change the behavior of a fire entering the fuel-altered zone and as anchor points for indirect attack on wildland fires (Agee et al. 1998). Fuelbreaks used as anchor points for fire control lines can help expedite containment of wildfires, but excessive long-range spotting from crown fires can sometimes make fuelbreaks ineffective (Green 1977). For this reason, fuelbreaks and project area fuel treatments should be viewed as complimenting one another rather than as completely separate options or substitutes for one another (Agee et al. 2000).

Desired Fire Behavior

The 1995 Federal Wildland Fire Management Policy identified guiding principles that are fundamental to wildland fire management. The first and most important guiding principle is that safety of firefighters and the public is the top priority in every fire management activity. In a national survey, nearly 80% of all wildland firefighters identified fuel reduction as the single most important factor for improving their margin of safety on wildland fires (Tri-Data 1996). Experience has shown that firefighters can more safely and successfully fight a fire if it stays small (largely determined by fuel size), has lower intensities (determined by fuel structure and accumulation), has relatively little spotting potential (determined by potential firebrand source, how far firebrands travel, and probability of igniting fuels upon landing), and low resistance to control (suppression force required to control a unit of fire perimeter).

The desired fire behavior would have rates of spread such that existing fire suppression forces are capable of successfully containing fires under the guidelines of the Revised Forest Plan. Light fuels such as grass and pine litter allow rapid line construction as compared to heavy accumulations of dead and downed fuels and are therefore considered more desirable. Flame lengths at the 90th percentile weather conditions would be four feet or less to ensure the effectiveness of hand crews (Rothermel 1983).

While surface fuels are important in this respect, canopy fuels are of more significance. Fires that burn in grass spread quickly, but they go out quickly and are more easily contained than intense surface or crown fires. Crown fires are often the most difficult to control, do the most ecological damage, and pose the greatest threat to firefighters and the general public. Torching and crowning trees are the source of most spotting during a wildfire. Therefore, it is desirable to limit the ability of a given wildfire to burn in the crowns of trees. Limiting crown fires offers firefighting forces the opportunity to take

swift, effective suppression action, increasing the likelihood that suppression objectives will be met.

Environmental Consequences

Direct, Indirect and Cumulative Effects

Effects of Silvicultural Treatment Common to Action Alternatives

Proposed *thinning from below* would reduce the ladder fuels in ponderosa pine stands. Larger trees remaining on the site would be more resistant to fire due to decreased flame lengths from the removal of ladder fuels. Thinned stands would be less likely to support running crown fires. Alternatives 2 and 4 would generally reduce the density of existing stands more than would Alternative 3.

Risk of mountain pine beetle infestation would decrease in thinned stands. As a result, likelihood of crown fires, fire residence time, and fire resistance to control would also decrease in treated stands. Stands that have high mortality and retain dried needles are considered very flammable and can transition to crown fire more readily than live pine trees. After needle drop the hazard will be reduced but the ¼ inch and larger surface fuels will increase substantially once the trees begin falling. Large amounts of heavy fuels increase the resistance to control due to increased spotting, more heat and longer residence time. Fire line construction rates would also be substantially reduced, increasing the likelihood that a hot fire can spread to neighboring stands. Stands with high mortality are also hazardous to suppression forces due to falling snags, and a large volume of material that is receptive to spot fires.

Reducing stand density, limiting ladder fuels, and reducing pine beetle mortality would lower the chance that a wildfire would escape initial attack and subsequently spread to adjacent private lands.

Mechanical *whole-tree harvest* removes most of the activity fuels from the stand and deposits them at central processing landings for treatment. Stands harvested in this manner have a lower fuel hazard due to reduced canopy density, ladder fuels, and loading of fuels three inches and less in diameter. This practice also creates fuel conditions suitable for conducting low-intensity prescribed burning (Revised Forest Plan FEIS). Whole-tree harvest would be used under all action alternatives in stands proposed for commercial treatment.

Prescribed burning is proposed under all action alternatives. Proposed burns would reintroduce low-intensity ground fire, an important disturbance process in Black Hills ponderosa pine ecosystems. Objectives include reduction of surface fuels, reduction of ladder fuels by pruning lower branches, and reduction of canopy fuels by killing some of the smaller conifer trees. Mortality would be variable but would generally increase as tree size decreases. In most stands, mortality would be limited to 75% of the trees 0-3" in diameter, 50% of the trees 3-5" in diameter, 20% of the trees 5-9" in diameter, and 10% of the trees 9" and greater in diameter.

Proposed burning would reduce surface fire intensity and ladder fuels. Trees killed by the burns would eventually add to surface fuels but would include few fine fuels. The

resulting small increase in surface fuels would be offset by the overall reduction in fuel hazard. Scorching of lower branches and resulting increase of crown base height would help move the project area towards desired future conditions by reducing ladder fuels.

Site-specific burn plans would be prepared for all prescribed burns. Burn plans for hardwood stands would emphasize growth and suckering of hardwoods and mortality of most of the small encroaching pines. Small hardwoods are more likely than pine to be top-killed by fire but quickly re-sprout from the roots and often grow with increased vigor following burning. Burning can be expected to increase the percentage of hardwoods in stands that currently have a mixed conifer/hardwood understory.

Burning in grasslands and meadows encroached by pine seedlings would kill a large percentage of these small trees. Future fire behavior would be moderated by maintaining these areas as non-forested grasslands.

Shaded fuelbreaks proposed under all action alternatives would substantially alter expected fire behavior in areas where stocking of both small and large trees is reduced. In some parts of the fuelbreaks, only smaller trees would be removed. Wildfire suppression in these areas would require more effort than in areas where both large and small trees are thinned. Less flammable patches of hardwoods along the fuelbreaks would be favored by reducing the pine trees in and directly adjacent to the site.

Hardwood restoration treatments would reduce the percentage of pine in mixed conifer/hardwood stands and the flammability of these stands. Following treatment, sites dominated by hardwoods would have low fire hazard and very unlikely to support crown fires.

Bait and sanitize treatments would not substantially alter the fuel hazard rating for entire stands, but would create openings within stands that would substantially reduce crown fire intensity. These openings would range in size from 0.1 acre to several acres.

Proposed *patchcuts* (Alternative 3 only) would create habitat diversity in monocultures of young regenerating pine stands. All trees in a two to ten acre area would be removed. One or more patchcuts would occur on approximately 25% of acreage within a given treatment stand, and would not exceed 30% of stand acreage. Residual slash would be lopped and scattered, piled and burned, or jackpot or broadcast burned.

Proposed treatments that reduce risk of beetle-caused mortality would result in fuel hazard reduction. Actions that would decrease stand susceptibility to attack by insects and disease would also decrease their susceptibility to wildfire (Revised Forest Plan FEIS). Wildfire and pathogens are closely related, with one often following another. Insects and disease increase the amount of dead fuel material in the forest, which in turn increases the intensity of wildfire. For this reason, any successful effort to control forest insects and disease is likely to have a corresponding effect in reducing the threat of wildfire.

Road construction associated with the action alternatives may speed access of fire suppression resources. Road construction may also increase access by the public and potentially, the risk of an ignition in that area. The advantages that roads provide including faster response times and their use as control lines offset the increased risk of human-caused fire (Revised Forest Plan FEIS).

Effects on Surface, Ladder and Canopy Fuels

Effects of the proposed activities on the fuel complex in the project area are an important gauge for understanding how fire suppression action would be impacted. Within the project area, surface fuels are not expected to change dramatically as the result of any of the alternatives. Slash that normally would be produced by commercial harvest operations would be removed from the site through whole-tree yarding. An increase in surface fuels is expected in areas that would be non-commercially thinned, since not all of the slash and stems in these areas would be removed. Slash left on site would be lopped and scattered to a depth of 18" or less. Needles, the most flammable aspect of the slash, are expected to drop from the branches within three years. Decomposition rates in the Black Hills normally reduce fuel hazard loading within harvested stands to pre-harvest levels within seven to ten years.

Changes in fire hazard rating was calculated for each alternative to display the overall hazard to the project area. Alternative 4 would cause the greatest reduction in average hazardous fuel ratings, followed by Alternative 2. Alternative 3 would also reduce the average fuel hazard ratings, but to a lesser degree than Alternative 2 or 4. All of the action alternatives would result in overall lower hazardous fuel ratings than would the no-action alternative. Calculations appear to show that fuel hazard rating in some treated stands would not change. This occurred in stands with steep slopes, where prescribed fire and non-commercial thinning are proposed. In these areas, access, cost and feasibility of commercial harvest was the limiting factor in the treatment prescription. Slope steepness cannot be changed and is important in determining the hazard rating of the stand. Although the stands would not move to a lower rating, they would be at the low end of the class they are in. Non-commercial thinning and prescribed fire would both reduce the ladder fuels and raise the canopy base height, reducing the overall hazard. The exception is where large amounts of thinning slash would be left in place; this would have a temporary effect on fire behavior by increasing the intensity of a surface fire. This would, however, be a short term effect, which would be offset by the aforementioned changes to canopy fuels.

Table 47 Reduction of Fuel Hazard Ratings

| ACRES OF MEDIUM- AND HIGH-HAZARD FUELS TREATED | | | | |
|---|----------------------|----------------------|----------------------|----------------------|
| | ALTERNATIVE 1 | ALTERNATIVE 2 | ALTERNATIVE 3 | ALTERNATIVE 4 |
| HIGH | 0 Ac | 1,885 Ac | 1,712 Ac | 2,191 Ac |
| MEDIUM | 0 Ac | 1,904 Ac | 1,609 Ac | 2,020 Ac |

In order to better understand how the proposed changes in the fuel hazard rating would affect the project area, fire behavior and effects were estimated based upon inventoried stand data. Using the best available data, changes in flame length, canopy base height, canopy bulk density, torching and crowning indices, and fire type were modeled for sample stands under each of the action alternatives.

Effects of alternatives were determined using the Forest Vegetation Simulator (Central Rockies variant), the Nexus fire behavior program, and the RMRIS database. Data was not available for all stands in the project area, but all types of treatments were represented in the sampled analysis. The existing condition was used for the no action alternative. Although stand conditions will continue to change over time, the within-stand fuel complex is not likely to see major changes with the next five to ten years.

Models simulate complex systems and estimate future conditions. Simulation models are useful for informing decision-makers and as support tools to document scientific basis for land management decisions (Eav 2002). Models are helpful in providing overall trends in hazards and factors contributing to those hazards, and they provide land managers a tool for alternative comparison, but they are simplified abstractions of reality (Atkins and Lundberg 2002). They are simplified abstractions of reality (Atkins and Lundberg 2002).

Proposed activities would reduce the intensity of fire behavior due to lower crown fraction burned. In most cases the expected fire behavior would be a surface fire with flame lengths of less than four feet. Surface fuels would resemble current conditions, but the fuel “ladder” would decrease and canopy density would be lower. Results over time would include less intense wildfires with less spotting from torching and crowning trees. Overall effects on vegetation from a wildfire would be less severe. Intensive treatment of natural and activity fuels near private property and along strategic locations such as fuelbreaks would lessen the intensity of a wildfire in these locations, increasing firefighter safety.

Non-commercial thinning treatments where slash is not removed would result in surface fires more intense than under the existing conditions, but this would lessen after three years due to needle drop. Treatments such as lopping and scattering, crushing, piling and burning, jackpot/broadcast burning, and fuel break construction would accelerate decomposition, reduce fire line intensity, and/or break up fuel continuity. Fuel treatment efforts would modify or reduce the amount of dead material less than three inches in diameter. Harvesting mechanics such as whole-tree yarding, which removes the entire tree to a central processing location, substantially reduce the fuel hazard of a stand immediately following harvesting. This type of harvest has an immediate and substantial effect in reducing wildfire rates of spread and intensity, which contribute to reduced resistance to fire-control operations. This method would be used in stands proposed for commercial treatment.

Predicting surface fire behavior in treated stands requires assigning surface fuel parameters. National Fire Behavior Prediction System (Behave) Fuel Models 2 and 9 were used for pre- and post-treatment conditions for whole-tree harvest stands. For stands without whole-tree harvest, Fuel Model 11 was used when enough slash was deposited to override the existing fuel model before treatment. The resulting predicted flame length average incorporated the crowns of burning trees when that type of fire was predicted. All action alternatives averaged approximately four-foot flame lengths in treated stands. The no action alternative averaged nine-foot flame lengths in the same stands. Hand crews can be effective at containing wildfires with four-foot flame lengths, but only mechanized equipment such as dozers and airtankers are effective on the head of a fire with nine-foot flames.

The change to “ladder” fuels is reflected by the height to live canopy base. All action alternatives would raise canopy base height. CBH would be approximately 16 feet higher

after Alternative 2 or 4 as compared to the no action alternative. Alternative 3 would raise CBH by an average of 13 feet. This is a substantial change from the existing condition. After implementation of Alternative 3, a given wildfire burning under the same conditions would need to be approximately 60% hotter to transition to passive crown fire as compared to Alternative 1. After Alternative 2 or 4, a fire would need to burn approximately 70% hotter as compared to Alternative 1.

Canopy fuels are measured by their mass and arrangement. All action alternatives would reduce canopy bulk density in treated stands. Mean canopy bulk density for sample stands proposed for treatment would be .049 kg/m³ under Alternative 1, .033 kg/m³ under Alternatives 2 and 4, and .031 kg/m³ under alternative 3. As a result of the higher canopy base height and reduced canopy bulk density, the required rate of spread for a surface fire to transition to a crown fire under Alternative 3 would be approximately 2.5 times that of the no action alternative. Under Alternatives 2 and 4, required rate of spread would be approximately three times that of the no action alternative. This means that, compared to the no action alternative, the action alternatives would result in less intense fire behavior given the same weather conditions.

Table 48 Fuels and Fire Behavior Indicators

| Average Values for Sample Stands: | ALTERNATIVE 1 | ALTERNATIVE 2 | ALTERNATIVE 3 | ALTERNATIVE 4 |
|--|------------------------|-------------------------|-------------------------|-------------------------|
| Canopy Base Height | 15 FT | 31 FT | 28 FT | 31 FT |
| Canopy Bulk Density | .049 KG/M ³ | .033 KG/ M ³ | .031 KG/ M ³ | .033 KG/ M ³ |
| Torching Index | 29 MPH | 57 MPH | 51 MPH | 57 MPH |
| Crowning Index | 49 MPH | 64 MPH | 54 MPH | 65 MPH |
| Flame length | 9 FT | 5 FT | 4 FT | 5 FT |

A high torching index does not necessarily mean that a stand will not exhibit crown fire. If a crown fire from outside the stand burns into a stand with a low crowning index, the crown fire can be maintained even though it would not be likely to originate there. Neither of the indices should be taken out of the context of the other. Sustained crown fire runs are, however, considered more difficult to control than the torching of groups of trees. It is also important to note that the stated indices are for a given set of weather conditions. Drought and other factors can cause more intense fire conditions, which would change the wind speed at which a wildfire can become involved in the crowns of trees.

When the surface fuels, CBH, and CBD are each examined in the context of the other factors, meaningful fire behavior predictions can be made. Fire behavior factors such as flame length and the type of fire (surface, passive, conditional, or active) are good measures of the potential difficulties that suppression resources will encounter on a wildfire.

Flame length and fire type are important aspects of fire behavior. These factors determine the type of firefighting resources needed and how resistant to control the fire will be. The predicted fire type for stands proposed for treatment was compared to the no action alternative to demonstrate the expected change. Alternatives 2 and 4 would reduce fire behavior the most in stands with active crown fire currently predicted. These alternatives would reduce active crown fires to surface fires in 85% of the treated stands. Alternative 3 would have this effect in 75% of treated stands. In 79-80% of the stands where passive crown fire would be predicted under the no action alternative, the action alternatives would cause the fire to stay on the ground.

Table 49 Percent of Post Treatment Fire Type for Treated Units

| ALTERNATIVE 1 (NO ACTION) | ALTERNATIVE 2 | | | ALTERNATIVE 3 | | | ALTERNATIVE 4 | | |
|----------------------------------|----------------------|---------|---------|----------------------|---------|---------|----------------------|---------|---------|
| Fire Type | Active | Passive | Surface | Active | Passive | Surface | Active | Passive | Surface |
| Active Crown | 7% | 7% | 85% | 7% | 18% | 75% | 7% | 7% | 86% |
| Passive Crown | 0 | 21% | 80% | 0 | 21% | 79% | 0 | 20% | 80% |
| Surface | 0 | 0 | 100% | 0 | 0 | 100% | 0 | 0 | 100% |

Fire regime condition class can help identify the level of change to one or more of the following: fire size, intensity, severity, and landscape patterns. As such, the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure can be understood. The following table compares the amount of land in each condition class under each alternative. Condition class is a fairly broad characterization, and allows for a range of stand structures and conditions within the class.

Table 50 Fire Regime Condition Class

| FIRE REGIME CONDITION CLASS | | | |
|------------------------------------|--------------------------|---------------------------|----------------------------|
| | CONDITION CLASS I | CONDITION CLASS II | CONDITION CLASS III |
| ALTERNATIVE 1 | 12,242 Ac | 11,925 Ac | 20,599 Ac |
| ALTERNATIVE 2 | 16,025 Ac | 10,027 Ac | 18,714 Ac |
| ALTERNATIVE 3 | 15,826 Ac | 10,055 Ac | 18,885 Ac |

| | | | |
|----------------------|-----------|----------|-----------|
| ALTERNATIVE 4 | 16,457 Ac | 9,901 Ac | 18,138 Ac |
|----------------------|-----------|----------|-----------|

Effects on Fire Regime Condition Class

Alternative 4 would reduce condition class for the greatest number of acres, followed by Alternative 2, then Alternative 3.

Overall, Alternative 4 would result in the lowest fuel hazard of any alternative, and fire behavior would be the least severe, followed by Alternatives 2, 3, and finally 1. Alternatives 2 and 4 also would treat more acres in the vicinity of high values. Alternative 4 would treat 10,585 acres within ½ mile of private property, while Alternative 2 would treat 9,826 acres within the same distance of private property. Alternative 3 would treat 9,006 acres in the same area. Of the remaining high hazard areas in the project area, 2,630 acres are being treated as part of activities authorized by P.L. 107-206 (see cumulative effects for resulting condition class). Other areas tend to be small trees or are fairly remote, isolated sites, and therefore are not proposed for treatment at this time.

Fires that start after implementation of any of the action alternatives would be more manageable. Opportunities for immediate suppression would have increased, since fewer areas would exhibit intense surface or crown fire behavior. Within three years of the non-commercial thinning, surface fire intensity would decrease substantially due to needle drop from slash. Within seven to ten years of the treatment, surface fire intensity would return to pre-treatment levels due to decomposition of most of the remaining slash.

The time lapse involved in detection and initial attack of wildfires is an important factor in determining the effectiveness of a suppression effort. For this reason, suppression advantages exist for those alternatives with additional roads.

Cumulative Effects

Effects of Legislated Treatments

P.L. 107-206 authorized 8,000 acres of treatment on National Forest System lands to reduce fire and mountain pine beetle hazard. Approximately 3,372 acres of this treatment will occur within the project area boundary. These areas will have low fire hazard following completion of the treatments. Active crown fire is not predicted to occur within these stands under 90th percentile weather conditions.

The area analyzed for cumulative effects is the eighteen 7th order watersheds that encompass the project area and activities undertaken due to P.L. 107-206.

Past and Planned Treatments

The following table identifies 41 timber sales that have taken place all or partly within the Elk Bugs and Fuel project area since 1982. Timber harvest took place prior to 1982, but few records are available. Sales resulting from P.L. 107-206 are not included. Many

of the early-1980s salvage sales listed harvested timber damaged during an October 1982 snowstorm.

Table 51- Recent Timber Sales within Elk Bugs and Fuels Project Area

| Sale Name | Years of Harvest Activity | Sale Name | Years of Harvest Activity |
|------------------------|---------------------------|------------|---------------------------|
| Chicken | 1982-1984 | Tilford | 1986-1993 |
| Spring Run Salvage | 1982-1983 | Monument | 1986 |
| Polo Salvage | 1982 | Nasty | 1986-1988 |
| Hill Salvage | 1983 | Runkle | 1986-1987 |
| Rooster Salvage | 1983 | Kelly | 1986-1990 |
| Three Draws Salvage | 1983 | Dalton | 1986 |
| Virkula Salvage | 1983 | Hay | 1989-1991 |
| Tilford Salvage | 1983 | Lost | 1989-1994 |
| Pullet Salvage | 1983 | Pit Resale | 1991-1992 |
| Cave Salvage | 1984 | Cave | 1992-1996 |
| Crook Mountain Salvage | 1984 | Vanocker | 1994-2000 |
| Left Salvage | 1984 | Roost | 1994-1997 |
| Lost Salvage | 1984 | Boomer | 1997-2000 |
| Park Creek Salvage | 1985-1987 | Deadman | 1997-2001 |
| Pigtail Salvage | 1985-1986 | Kirk | 1998-2000 |
| Red Hill | 1985-1987 | Pit | 1998 |
| Kirk Hill | 1985 | Piedmont | 1999-2000 |
| Pine | 1985 | Boulder | 2001-2002 |
| Polo | 1985 | Redhill | 2002 |

| Sale Name | Years of Harvest Activity | Sale Name | Years of Harvest Activity |
|--------------|---------------------------|-----------|---------------------------|
| Chicken Bugs | 1985 | Roubaix | 2002 |
| Sid Bugs | 1985 | | |

These actions thinned affected stands, reducing fire hazard. Due to the prolific regeneration of ponderosa pine in the Black Hills, most stands started moving back towards a more hazardous condition class following treatment. Fuels in previously treated stands do not pose a substantial threat to adjacent stands due to the reduction in stand density.

The following table lists the acres of vegetation treated in timber sales since the early 1980s and planned for treatment in recent sales. The resulting condition class is given for each activity. This table does not include treatments planned and implemented under P.L. 107-206.

Table 52- Acres of Vegetation Treatment; 1980s - Planned (RMRIS data)

| Resulting Condition Class | Treatment Description | 1980s | 1990s | 2000s | Planned |
|---------------------------|--|-------|-------|-------|---------|
| 1 | Clearcut | 182 | 239 | 32 | 76 |
| 2 | Shelterwood preparation | 0 | 0 | 90 | 0 |
| 1 | Shelterwood seedcut | 646 | 1749 | 100 | 188 |
| 2 | Shelterwood removal and overstory removal | 143 | 629 | 45 | 307 |
| 2 | Uneven-aged management – group selection | 0 | 0 | 0 | 16 |
| 2 | Thin | 8,840 | 3,634 | 51 | 7 |
| 2 | Salvage | 1,700 | 0 | 0 | 0 |
| 1 | Special cut (aspen, aspen/birch maintenance and enhancement) | 0 | 0 | 50 | 58 |
| 2 | TSI – Precommercial thinning | 1,344 | 2,144 | 218 | 74 |
| 1 | Habitat improvement - tree encroachment control | 0 | 0 | 13 | 264 |

| | | | | | |
|---|---|-----------------|----------------|-------------|---------------|
| 1 | Regenerate aspen – clearcut | 458 | 356 | 7 | 54 |
| 1 | Tree encroachment control | 0 | 321 | 40 | 103 |
| | Total Acres Treated by Decade (% of Forested Area) | 13,313 (28%) | 9,072 (19%) | 646 (1%) | 1,147 (2%) |

Condition class was assigned based upon the type of treatment the stand received. Due to the exclusion of fire and most other disturbances, treatments conducted during the 1980s are moving back toward a more severe condition class.

Current Actions

Approximately 3,372 acres of harvest activity and fuel breaks are planned within the project area under P.L. 107-206. Treatments are expected to occur within the next five years. These activities will result in less hazardous fuel conditions. Crown fire is not predicted to occur in these stands under 90th percentile weather conditions. Using the parameters established for this project, condition class in these sites is predicted to move to Condition Class 1. These treatments will further reduce the threat of large crown fires in the project area.

Timber sales currently under way in the project area include Boulder, Dano, Kirk, Piedmont, Redhill, and Cavern. These sales can be expected to reduce stand density in harvest units, resulting in less hazardous conditions.

Wildland-urban interface areas are likely to increase due to the continued development of privately owned property. Some small-scale fuel reduction activities are likely to occur on these lands as the result of clearing for home sites and continuing education of homeowners by local, state and federal fire management agencies. These areas will assist fire suppression activities in the area, mostly by providing additional defensive space for firefighters working adjacent to homes.

Cumulative Effects

Table 53 displays cumulative effects on Condition Class.

Table 53 Fire Regime Condition Class

| FIRE REGIME CONDITION CLASS | | | |
|------------------------------------|--------------------------|---------------------------|----------------------------|
| | CONDITION CLASS I | CONDITION CLASS II | CONDITION CLASS III |
| ALTERNATIVE 1 | 15,614 Ac | 11,183 Ac | 17,969 Ac |
| ALTERNATIVE 2 | 19,397 Ac | 9,285 Ac | 16,084 Ac |
| ALTERNATIVE 3 | 18,460 Ac | 10,049 Ac | 16,255 Ac |
| ALTERNATIVE 4 | 19,829 Ac | 9,159 Ac | 15,778 Ac |

Connectivity to other areas. Outside the project area, the cumulative effects area includes 45,642 acres of National Forest System lands and 6,124 acres of other ownership. Included in the analysis is the Beaver Park Inventoried Roadless Area and an additional five watersheds containing activities resulting from P.L. 107-206.

Most wildfires in the area have been relatively small, inducing little mortality in the overstory, but reducing surface fuels in the short term. Several large fires have occurred in the cumulative effects analysis area. The Lost Gulch fire in 1931 burned 402 acres. The Big Elk fire burned 1,576 acres in 1949. The project area includes only a small portion of the 4,547-acre Deadwood fire (1959), but the cumulative effects area includes 25% of this fire. These fires had severe effects, evidence of which still exists today. The Big Elk burn was replanted in the 1950s, resulting in dense stands of relatively small trees. The Little Elk fire of 2002 burned 484 acres of private and National Forest System lands. Mortality was mixed but generally low on public land; timber on about half of the intensely burned private land has been salvaged.

The Grizzly Gulch fire of 2002 burned approximately 11,589 acres, including 5,608 acres in the project area (3,025 acres of National Forest System lands). The majority of the acres within and adjacent to the project area burned with relatively low intensity, which resulted in less surface fuels and higher crown base heights due to mortality to smaller trees, and pruning of lower branches of larger trees. Approximately 240 acres burned with high mortality. As a result, the area immediately to the northwest of the project is relatively safe from intense wildfires in the next 10 years. It is unlikely that an intense wildfire will enter the project area in the near future from the area burned in the Grizzly Gulch fire.

Approximately 4,628 acres of treatment are planned and or ongoing in the cumulative effects area but outside the project area due to P.L. 107-206. Non-commercial treatment is occurring on 700 acres in the Forbes Gulch area, and fuelbreaks are being constructed on 117 acres along the boundaries of Beaver Park. These treatments are expected to be completed within the next two years. The activities will result in less hazardous fuel conditions. Crown fire is not predicted to occur in these stands under 90th percentile weather conditions. Using the parameters established for this project, Condition Class in these sites will move to Class 1. These treatments will further reduce the threat of large crown fires in the project area by reducing the likelihood that a fire originating in these areas could burn into the project area.

Other past actions in the project area include timber harvest, silvicultural management such as thinning, fuels management and wildfire suppression, grazing, mining, recreation, wildland-urban interface development, utility line development, wildlife management, and road construction.

Timber harvest has occurred in the area since the early 1890s. The following table displays recent timber sales within the cumulative effects area.

Table 54 Recent Timber Sales within the Cumulative Effects Area

| Sale Name | Years of Harvest Activity | Sale Name | Years of Harvest Activity |
|------------------|----------------------------------|--------------------------|----------------------------------|
| Benchmark | 1979-1986 | Hay | 1989-1991 |
| Stagebarn | 1981-1989 | Lucky | 1989-1993 |
| Airport Salvage | 1982 | Novak | 1991-1993 |
| Greenwood | 1982 | Pit resale | 1991-1992 |
| LS Salvage | 1984 | Greenmont | 1991 |
| Wilson Salvage | 1984 | Cave | 1992 |
| Erskine | 1985 | Flagstaff | 1992-1993 |
| Lucky East bugs | 1985 | Dump | 1993 |
| Lucky west bugs | 1985 | Greenwood | 1997 |
| Dalton | 1986-1993 | Bench | 1997 |
| Kelly | 1986-1990 | Kine | 1997-1998 |
| Skislide | 1988-1991 | Kirk | 1998-present |
| Wilson | 1988 | Cavern | 1999-present |
| Misty | 1989-1990 | Public Law 107-206 Sales | 2002-present |

The following table lists the types and acres of vegetation treatment in timber sales on National Forest System lands in the cumulative effects area since the 1980s, planned timber sales, and treatments planned under P.L. 107-206. The resulting condition class and acres relative to the action are included.

Table 55 Past, Present and Foreseeable Timber Sales

| Resulting Condition Class | Treatment Description | 1980s | 1990s | 2000s | Planned | Total Acres |
|----------------------------------|--|--------------|--------------|--------------|----------------|--------------------|
| 1 | Clearcut | 182 | 239 | 32 | 76 | 529 |
| 2 | Shelterwood preparation | 0 | 0 | 90 | 0 | 90 |
| 1 | Shelterwood seedcut | 646 | 1749 | 100 | 188 | 2683 |
| 2 | Shelterwood removal and overstory removal | 143 | 629 | 45 | 307 | 1124 |
| 2 | Uneven-aged management – group selection | 0 | 0 | 0 | 16 | 16 |
| 2 | Thin | 8,840 | 3,634 | 51 | 7 | 12532 |
| 2 | Salvage | 1,700 | 0 | 0 | 0 | 1700 |
| 1 | Special cut (aspen, aspen/birch maintenance and enhancement) | 0 | 0 | 50 | 58 | 108 |
| 2 | TSI – Precommercial thinning | 1,344 | 2,144 | 218 | 74 | 3780 |
| 1 | Habitat improvement - tree encroachment control | 0 | 0 | 13 | 264 | 277 |
| 1 | Regenerate aspen – clearcut | 458 | 356 | 7 | 54 | 875 |
| 1 | Tree encroachment control | 0 | 321 | 40 | 103 | 464 |
| 1 | Forbes Gulch Fuel Treatments | | | | 700 | 700 |

| | | | | | | |
|---|---|--------------|-------------|----------|------------|-----|
| 1 | Beaver Park - Forest Boundary Fuel Break | | | | 117 | 117 |
| | Total Acres Treated by Decade (% of Forested Area) | 13,313 (28%) | 9,072 (19%) | 646 (1%) | 1,147 (2%) | |

Current timber sales on National Forest system lands outside the project area but within the cumulative effects area include Kirk, Cavern, and P.L. 107-206 sales. Wildfires are aggressively suppressed. Maintenance of developments continues, as do grazing and recreational activities. Some small-scale treatment of fuels on private property is occurring on a limited basis.

This project is in the vicinity of fuel reduction projects being conducted by the BLM, city of Lead, and private landowners in the exemption area north and west of the project area. Fuelbreaks, thinning, and prescribed burning planned by the BLM will reduce the likelihood of fire entering the project area from that direction.

Future Actions. Foreseeable actions include continued development in the wildland-urban interface, wildfire suppression and fuels management, recreation activities, wildlife management, livestock grazing, road maintenance, and vegetation management. Planned timber sales that include management of activity fuels and non-commercial vegetation include Jimmy and Strike, both scheduled for 2004.

Air Quality

National Ambient Air Quality Standards (NAAQSs) are established by the 1963 Clean Air Act and subsequent amendments. The Clean Air Act and amendments establish emission standards for stationary sources of emissions. Smoke from wildfires and prescribed fires have the potential to impact air quality. Airflow, including smoke, typically moves from west to east in the project area. Air quality and visibility in the Elk Bugs and Fuels analysis area is good to excellent, although some air degradation occurs temporarily from wildfires.

There are two federally designated class I air quality areas in the region: Wind Cave National Park located approximately 40 miles south of the project, and Badlands National Park located approximately 60 miles southeast of the project. Because it is temporary, smoke from wildfire or prescribed burning does not compromise Class I goals (BHNFLand and Resource Management Plan). Short-term impacts are possible however. Rapid City, South Dakota is located to the southeast of the project area and is designated by the EPA as a non-attainment area for PM-10.

There are numerous possible receptors within and adjacent to the project area such as roads, towns, subdivisions, and other air-quality sensitive areas, which are identified during the prescribed burning process. Burn prescriptions are developed to ensure that air quality standards are maintained in the receptor areas.

Direct and Indirect Effects

Alternative 1

Alternative 1 would have no direct or indirect effect to existing air quality.

Alternatives 2, 3, 4

All of the action alternatives include burning of brush piles and broadcast burn activities that produce smoke and would temporarily affect air quality. Prescribed burning is carried out in the fall, winter or spring when weather and fuel moisture conditions are conducive to meeting the objectives of the burn, mainly to reduce surface fuel loading and reduce density of tree stems, usually in the smaller diameter classes, to ultimately make the burned area more resilient to effects of a wildfire. Pile burning of debris is generally carried out with snow on the ground to minimize potential control problems.

The season in which burning takes place can effect smoke dispersal and therefore mitigate potential impacts. November through March have the highest probability for daytime inversions. Typically inversions are common during clear, calm, settled weather when warm air lies above the cool air surface layer. This condition traps smoke resulting in poor visibility and hazy conditions. Under poor dispersal conditions smoke can also be funneled down slope and toward lower elevations where most of the developed property is located, making smoke a public irritant.

The effects of burning slash piles and broadcast burning would be short term and dissipate within days or hours. Burning of slash piles would be done following harvest and piling, as necessary. Both PM10 and PM2.5 would be generated from pile burning. Material in the piles would be dry, allowing maximum consumption of all material. Lighting well-cured piles during the daytime with good venting conditions can maximize smoke dispersal, Limiting impacts downwind by minimizing smoldering, and reducing the amount of smoke moving down slope during the evening and nighttime. Drier fuels will also consume quicker, reducing residence time, thus reducing the particulate matter levels. Smoke produced is below the 150 micrograms per cubic meter (ug/m3) NAAQS standards of daily emissions.

Potential negative impacts from smoke can be eliminated if lofting heights are above 1000 ft and transport winds are not directly upwind of the receptor. Smoke concentrations will be greatest less than 4 miles from the burn area. PM10 production is not exceeded during fair to excellent stability and winds generally greater than 1 mph and less than 10 mph. Burning 60 landing piles a day under excellent to fair dispersal conditions only led to exceedences in very short distances, I.E. less than 2.5 miles. This is however for a concentrated area, and it is very unlikely that this number of piles would be located so close together. Burning fewer piles per day, burning with more wind, or burning under more favorable weather would reduce PM2.5 concentrations. In addition, burning will not occur when it will affect the Rapid City airshed while an air quality alert has been issued.

Table 56 Particulate Production

| Particulate Size Class | NAAQS standard for 24 hr period | Max 6 hr particulate production |
|------------------------|---------------------------------|---------------------------------|
| PM10 | 150 ug/m3 | 94 ug/m3 |
| PM2.5 | 65 ug/m3 | 61 ug/m3 |

Smoke dispersion is a key consideration in any decision to implement prescribed burns. Broadcast burn plans prepared by the Black Hills National Forest are required to contain a smoke management prescription, based upon daytime and nighttime smoke dispersal. They specify lofting heights, and acceptable smoke dispersal directions. Igniting burns under fair-to-excellent ventilation conditions and suspending operations under poor smoke dispersion conditions; will reduce the potential for impacts to air quality. Smoke concentrations will be greatest less than 4 miles from the burn area. Modeling a typical broadcast burn in Ponderosa Pine produces PM 10 particulate matter well within the allowable daily emissions, assuming 250 acres per day. The amount of PM2.5 is slightly lower than daily allowable emissions. The model assumes consistent smoke production through out the burning period. The maximum amount of PM2.5 produced during the burn would be about 63 ug/m3. If larger areas are burned in a 24-hour period, adjustments to the smoke management plan will be needed.

Table 57 Typical Broadcast Burn Factors

| Particulate Size Class | NAAQS standard for 24 hr period | Typical Broadcast burn: 250 acres/day |
|------------------------|---------------------------------|---------------------------------------|
| PM10 | 150 ug/m3 | Max. 73 ug/m3 |
| PM2.5 | 65 ug/m3 | Max. 62 ug/m3 |

Alternative 2 has less broadcast burning and slightly less pile burning than alternatives 3 and 4. Due to the temporary nature of smoke, and the ability to control the amount of burning conducted in a 24-hour period, the differences in effects to air quality for all of the action alternatives will be minor. None of the alternatives would substantially change the existing air quality, nor would there be significant differences in the effects of the alternatives on air quality. Burning will be implemented on days when air quality degradation can be minimized, especially near Rapid City. By following appropriate smoke dispersal guidelines, smoke impacts from prescribed burning and pile burning should be short lived, local in extent and within acceptable limits.

Cumulative Effects

The past impact having the greatest effect on air quality was the Grizzly Gulch fire that burned over 11,000 acres in 2002. This had a large immediate effect on the air quality of

the fire area, the District and beyond. Air quality issues associated with past activities have passed. Current activities such as pile and broadcast burning associated with timber sales, thinning and fuels reduction are coordinated on the district so that they do not act together to increase the effects.

Conclusion: Smoke production and emissions are within federal, state, and local air quality regulations. The proposed burning is of short duration, and following the appropriate guidelines, would not affect any non-attainment areas, and would not adversely affect Class I areas.

Biological Environment

Forest Vegetation

Affected Environment:

Existing Silvicultural Conditions

Background

The approximate 60,371-acre project area includes 44,766 acres of National Forest land and 15,605 acres of State and private lands. The National Forest lands are in five management areas.

Table 58- Forest Plan Management Areas (RMRIS data, GIS acres)

| Category | Management Area | Acres |
|----------|---|--------|
| 3.31 | Backcountry Motorized Recreation Emphasis | 426 |
| 3.32 | Backcountry Non-motorized Recreation Emphasis | 1,644 |
| 5.1 | Resource Production Emphasis | 11,604 |
| 5.2A | Fort Meade VA Hospital Watershed | 3,299 |
| 5.4 | Big Game Winter Range | 27,793 |

Table 59 displays timber suitability associated with the Forest Planning process. The suitability determination was used in developing the allowable sale quantity and does not imply that timber harvest would be limited to these lands. Unscheduled commercial harvest may occur on unsuitable lands to meet other multiple use objectives where provided for in standards and Guidelines (USDA Forest Service 1997).

Table 59- Timber Suitability (RMRIS data, GIS acres)

| Code | Suitability | Acres |
|------|--|-------|
| 511 | Suitable: Roaded Upland Forest, Tractor Logging | 3,835 |
| 521 | Suitable: Unroaded Upland Forest, Tractor Logging | 808 |
| 522 | Suitable: Unroaded Upland Forest, Cable Logging Area | 253 |
| 591 | Suitable: past wild-fire | 1,122 |
| 640 | Suitable: visual emphasis | 857 |

| Code | Suitability | Acres |
|-------|--|--------|
| 650 | Suitable: wildlife emphasis | 23,223 |
| 660 | Suitable: water emphasis | 2,421 |
| 710 | Unsuitable: stocking within 5 years cannot be assured | 276 |
| 721 | Unsuitable: topography prevents harvesting by tractor or cable systems | 2,557 |
| 722 | Unsuitable: irreversible resource damage to soils productivity or watershed conditions is likely to occur with harvest due to unstable soils | 342 |
| 801 | Tentatively Suitable: Managed for Other Multiple Use Objectives, Late Successional Site | 594 |
| 810 | Tentatively suitable: experimental forest, range, or watershed | 418 |
| 820 | Tentatively suitable: uneconomical | 347 |
| 821 | Tentatively suitable: steep slopes | 1,773 |
| 822 | Tentatively suitable: aspen | 1,650 |
| 823 | Tentatively suitable: road construction problem prevents access development | 503 |
| 824 | Tentatively suitable: isolated patch of forest land | 160 |
| 826 | Tentatively suitable: oak | 311 |
| 832 | Tentatively suitable: hardwoods | 46 |
| 871 | Tentatively suitable: back-country recreation | 1,738 |
| 891 | Tentatively suitable: pine converted to aspen | 474 |
| 892 | Tentatively suitable: pine converted to meadow | 236 |
| Blank | Grasslands and Non-Forested Lands | 822 |

Cover Types

Cover type is the current forest vegetation that dominates a site. The Elk Bugs and Fuels project area has five forest cover types: ponderosa pine, aspen, white spruce, other hardwoods, and three non-forest cover types: grass, rock, and non-forest. Ponderosa pine is, by far, the most common cover type on the project area. The following table shows the area in each forest and non-forest cover type.

Table 60- Forest Cover types (RMRIS data, GIS acres)

| Cover Type | Acres | % of N.F. Lands |
|-----------------------|--------|-----------------|
| Aspen | 1,650 | 4% |
| Bur oak | 311 | <1% |
| Other hardwoods | 46 | <1% |
| Ponderosa pine | 41,624 | 93% |
| White spruce | 313 | <1% |
| Grass | 657 | 1% |
| Non-forest or Unknown | 165 | <1% |

Habitat Types

Habitat type is the basic unit in classifying lands or sites based on potential, or climax natural vegetation. Climax vegetation is that which has attained a steady state with its environment. All stands of climax vegetation that have the same overstory and understory dominants are grouped into a single plant association. Plant associations are the fundamental units of plant community classification. Series is the next higher category of classification. Habitat types with the same potential climax dominant are grouped into series (Alexander and Hoffman 1987).

**Table 61- Habitat Types and General Characteristics
(RMRIS data; Johnston 1987)**

| Code | Plant Association | Description | Acres | % Of Project Area Forested Acres | Dominant Tree Species |
|-------|--|---|-------|----------------------------------|-----------------------|
| 01102 | <i>Pinus ponderosa/Schizachyrium scoparium-Elytrigia smithii</i> | Rocky breaks, hills and canyons, and watercourses, precipitation 18-20 inches per year, 4,800-5,500 feet elevation, pH 7.2-8.0, often derived from limestone. | 579 | 1% | Ponderosa pine |
| 01104 | <i>Pinus ponderosa/Bouteloua curtipendula</i> | Rough, stony land and canyon rims on exposures of limestone and limey sandstone, pH 7.3, sandy loams. | 201 | <1% | Ponderosa pine |
| 01108 | <i>Pinus ponderosa/Danthonia intermedia</i> | Shale, granite, or limestone, precipitation 18-20 inches per year, 4,950-5,500 feet elevation. | 1,886 | 4% | Ponderosa pine |
| 01110 | <i>Pinus ponderosa/Festuca idahoensis</i> | Well-drained loamy sand or sandy loam, gentle s-w aspects, pH 5.5-6.7, 4,300-6,000 feet elevation. | 100 | <1% | Ponderosa pine |
| 01112 | <i>Pinus ponderosa/Juniperus communis</i> | Silt loam, shallow soil, pH 5.1-6.8, 4,575-6,525 feet elevation. | 5,334 | 12% | Ponderosa pine |

| | | | | | |
|-------|--|---|--------|-----|---------------------------------------|
| 01113 | <i>Pinus ponderosa/Juniperus communis-Symphoricarpos albus</i> | Mesic uplands, limestone plateau, 5,670-6,780 feet elevation. Higher elevation, moist, cool sites. | 6,505 | 15% | Ponderosa pine |
| 01115 | <i>Pinus ponderosa-Juniperus scopulorum/Cercocarpus montanus</i> | Low elevation, more exeric ponderosa pine sites, sw-se slopes, precipitation 18-20 inches per year, limestone soils, 5000-5500 feet elevation | 775 | 2% | Ponderosa pine-Rocky mountain juniper |
| 01119 | <i>Pinus ponderosa/Physocarpus monogynus</i> | North aspects, 5140-5700 feet elevation. | 78 | <1% | Ponderosa pine |
| 01120 | <i>Pinus Ponderosa/Purshia tridentata</i> | Well-drained dry benches, dry slopes, 10-55%, predominately south aspects, sandy loams, PH 5.0-6.6. | 30 | <1% | Ponderosa pine |
| 01122 | <i>Pinus ponderosa/Padus virginiana</i> | Low-elevation, moist north facing slopes and draws, calcareous or non calcareous gravelly silt loam to silt loam soil, precipitation 20-22 in., pH 6.0-9.0. | 16,142 | 37% | Ponderosa pine |
| 01123 | <i>Pinus ponderosa/Spiraea betulifolia</i> | Loamy sand or loam soils, pH 5.9-7.1, mesic sites at higher elevations, 6100 feet elevation. | 1,021 | 2% | Ponderosa pine |
| 01124 | <i>Pinus ponderosa/Symphoricarpos albus</i> | Moderately steep slopes, mesic sites on non-calcareous soil, loam to silty clay loam, precipitation 20-22 inches per year. PH 5.1-6.4, 3,720-6000 feet elevation. | 2,989 | 7% | Ponderosa pine |

| | | | | | |
|-------|--|---|-------|-----|------------------------|
| 01126 | <i>Pinus ponderosa/Carex heliophila</i> | Rocky ridges and dry southerly slopes, foothills on borders and ridges I the plains, 4500-5170 feet elevation, precipitation 20 inches per year. PH 5.8-6.9. | 271 | <1% | Ponderosa pine |
| 01140 | <i>Pinus ponderosa/Arctostaphylos uva-ursi</i> | Gentle to steep lower slopes and ridges, all aspects, moderately deep to lithic soils, very dry and well drained, variety of textures, pH 4.7-6.7. Undergrowth is often sparse, elevation 5080-6700 feet. | 3,966 | 9% | Ponderosa pine |
| 01151 | <i>Pinus ponderosa/Quercus macrocarpa</i> | Rolling hills and ridge-tops, calcareous substrates in the northern Black Hills, sandy loams to clay loams, pH 5.3-6.0, elevation 4750-5300 feet. | 1,879 | 4% | Ponderosa pine-bur oak |
| 0501 | <i>Picea glauca/Carex peckii</i> | Upper canyons, north end of Black Hills, cool, damp, northeast aspects, soils rocky, with low to moderate clay content, moderately deep to deep. | 2 | <1% | White spruce |
| 0502 | <i>Picea glauca/Juniperus communis</i> | Cool, wet, uplands, silty loam soils, 17-57% n-w slopes, acid soils, PH 5.3-5.5. | 2,546 | 6% | White spruce |

| | | | | | |
|-------|---|---|-------|-----|---|
| 0503 | <i>Picea glauca/Linnaea borealis</i> | Northerly moderately steep (28-63%) slopes, loam soils, pH 5.4-7.3, elevation 5800-6430 feet. | 1,068 | 2% | White spruce |
| 10202 | <i>Ostrya virginiana/Crataegus succulenta</i> | Woody draws; small springs which flow from the clay layer in canyons, springs in deep canyons. | 7 | <1% | Eastern hophornbeam, paper birch, quaking aspen |
| 10203 | <i>Ostrya virginiana-quercus macrocarpa/sparse understory</i> | Moderately steep (28-47%) northerly slopes, sandy loam and loam soils, pH 5.8-7.4, elevation 3000-3500 feet. | 99 | <1% | Eastern hophornbeam, bur oak |
| 10402 | <i>Populus sargentii-P. angustifolia</i> | Low elevation riparian sites. | 36 | <1% | Plains cottonwood and narrowleaf cottonwood |
| 10502 | <i>Populus tremuloides/Corylus cornuta</i> | Well developed, deep soils from limestone, quartzite, shist, and tertiary volcanic, mostly northerly aspects, pH 5.7-6.2, elevation 4000-6150 feet. | 841 | 2% | Quaking aspen/paper birch |
| 10801 | <i>Betula papyrifera/Corylus cornuta</i> | Nearly level draws or top of draws, sandy loam or silt loam, pH 6.8-7.6, 0-30% north facing slopes. | 119 | <1% | Paper birch/bur oak/quaking aspen |

Ponderosa Pine

Much of the ponderosa pine cover type regenerated in the late 1800s or early 1900s after heavy logging and/or wildfires. Timber stands supplied early settlers with logs and lumber for homes and buildings, railroad ties, mining timbers, and fuel wood (USDA Forest Service 1996). Stands are predominately even-aged, with remnant over-mature trees that survived wildfires and logging. Table 62 displays the age-class of aspen, ponderosa pine, and white spruce stands based on stand year-of-origin. Year-of-origin is from RMRIS data and calculated by RMRSTAND, acres are from RMRIS.

Table 62- Cover Type Age-Class Based on Stand Year-Of-Origin (RMRIS data)

| Decade of Origin | Aspen (Acres) | Ponderosa Pine (Acres) | White Spruce (Acres) |
|-------------------------|----------------------|-------------------------------|-----------------------------|
| 1680-1689 | 0 | 51 | 0 |
| | | | |
| 1750-1759 | 0 | 29 | 0 |
| 1760-1769 | 0 | 0 | 0 |
| 1770-1779 | 0 | 95 | 0 |
| 1780-1789 | 0 | 47 | 0 |
| 1790-1799 | 0 | 134 | 0 |
| 1800-1809 | 0 | 150 | 0 |
| 1810-1819 | 0 | 281 | 0 |
| 1820-1829 | 0 | 359 | 0 |
| 1830-1839 | 0 | 389 | 0 |
| 1840-1849 | 0 | 653 | 0 |
| 1850-1859 | 0 | 1,297 | 0 |
| 1860-1869 | 0 | 2,564 | 0 |
| 1870-1879 | 0 | 3,612 | 60 |
| 1880-1889 | 6 | 5,964 | 0 |
| 1890-1899 | 258 | 8,103 | 33 |
| 1900-1909 | 160 | 7,255 | 29 |
| 1910-1919 | 113 | 4,747 | 113 |
| 1920-1929 | 161 | 3,374 | 70 |
| 1930-1939 | 65 | 1,262 | 4 |
| 1940-1949 | 24 | 642 | 4 |
| 1950-1959 | 0 | 1,392 | 0 |
| 1960-1969 | 91 | 451 | 0 |
| 1970-1979 | 0 | 927 | 0 |
| 1980-1989 | 374 | 584 | 0 |
| 1990-1999 | 250 | 432 | 0 |
| 2000-2002 | 0 | 0 | 0 |
| No Data | 148 | 815 | 0 |

Stands vary from pure ponderosa pine on drier sites, to ponderosa pine mixed with white spruce, quaking aspen, paper birch, bur oak, and/or hophornbeam, locally known as ironwood. Drainage bottoms have eastern hophornbeam and bur oak on the lower elevation sites. White spruce, quaking aspen, and paper birch are common in north aspect ponderosa pine stands.

Twenty-seven % (11,094 acres) of the project area's ponderosa pine stands are stocked at or greater than 60% AMD (average maximum density). Sixty % AMD is the upper limit of the management zone for ponderosa pine based on the Region 2 Stocking Guide (USDA Forest Service 1997). Twenty-one % of the ponderosa pine stands are fully stocked between 40% and 60% AMD, and 18% are at less than full stocking, 40% AMD.

In some areas, stand stocking has been reduced due to mountain pine beetle caused mortality. Table 63 displays stocking for all cover types throughout the project area.

Table 63- Stocking by Cover Type Based on % of Average Maximum Density (AMD); Acres (% of cover type)

| Cover Type | Under stocked 1-39% AMD | Fully Stocked 40-59% AMD | Overstocked 60%+ AMD | No Data |
|-------------------|------------------------------------|-------------------------------------|---------------------------------|-----------------|
| Aspen | 715 acres (43%) | 325 acres (20%) | 0 acres | 610 acres (37%) |
| Other hardwoods | 0 | 0 | 0 | 46 (100%) |
| Ponderosa pine | 7,582 (18%) | 8,855 (21%) | 11,094 (27%) | 14,093 (34%) |
| White spruce | 205 (65%) | 62 (20%) | 0 | 46 (15%) |
| Bur oak | 5 (2%) | 0 | 0 | 306 (98%) |

Quaking Aspen

The quaking aspen cover type make up only 4% of the project area forest cover type, however aspen is a component of many ponderosa pine stands on northwest to east aspects throughout the project area. Aspen is a relatively short lived, shade-intolerant, pioneer species, which regenerates well after disturbance through vegetative sprouts (DeByle and Winokur 1985). The stands and inclusions became established, or re-established, due to stand replacing fire events near the turn of the last century and are in decline. Aspen is climax on only 2% (841 acres) of the project area; the remainder of the aspen is seral to ponderosa pine or white spruce. Through time and with no disturbance, ponderosa pine and/or white spruce would gradually take over these sites.

Paper Birch

No stands in the project area have been identified with a paper birch cover type, however paper birch exists throughout the project area on north and east facing slopes and along drainage bottoms. Birch is found in pine, aspen, and oak stands. Like aspen, birch is a relatively short-lived, shade-intolerant pioneer species (USDA Forest Service 2002). Birch became established or re-established due to stand replacing fire events near the turn of the last century, and are now in decline. Birch is climax on less than 1% (119 acres) of the project area, and these stands likely have a current cover-type of aspen or oak, based on predominant stocking.

White Spruce

White spruce is dominant on only 313 acres of the project area, however it is common within the understory of ponderosa pine stands on moist sites throughout the project area. With no wildfire or other stand-replacing disturbance, the amount of spruce cover type will continue to increase across the project area. Wildfire, a common occurrence before

the 1900s (Sheppard and Battaglia 2002), limited white spruce to moist sites such as draw bottoms and steep north aspects (USDA Forest Service 2002). White spruce is climax on 8% (3,616 acres) of the project area. Where spruce is climax, it will become the dominant species if fire does not burn through the stand.

Bur oak

Bur oak occurs as an understory species associated with ponderosa pine, as a dominant shrub, or as individual trees in ravines and riparian areas along the edge of the Black Hills (Sheppard and Battaglia 2002). Bur oak is currently the dominant tree species on 311 acres. Bur oak is relatively shade intolerant, and regenerates through root and stump sprouts after wildfire.

Other Hardwoods

Stands classified as other hardwoods include mixed stands of bur oak and eastern hophornbeam (ironwood), aspen, and birch.

Insects and Disease

Mountain pine beetle (*Dendroctonus ponderosae*) is the number one insect killer of pines throughout the western United States. The beetle is a native species to the West and attacks most pine species, including ponderosa pine in the Black Hills (Allen et al. 2002).

The mountain pine beetle has one generation per year in the Black Hills. Adult flight occurs in July-August, when adults leave previously infested trees and attack un-infested, green trees. Attacking adults chew through the bark and construct galleries along which eggs are laid. Larvae hatch from the eggs and begin feeding on the phloem of the tree in late summer or early fall. Larvae, pupae, or new adults over-winter under the bark of the infested tree. In the spring, the beetle finishes its maturation process, producing the next generation of adults. The larvae kill trees by feeding on the inner bark or phloem and cutting off sugar flow from the needles to the roots. The introduction of blue stain fungus by the beetles causes clogging of the water conducting tissues in the tree, speeding up the tree's death (Allen et al. 2002).

Mountain pine beetles generally infest ponderosa pine trees that are between 8 and 12 inches in diameter, although trees larger than 20 inches have been attacked (Sheppard and Battaglia 2002). Stand density is the driving factor of a potential outbreak of mountain pine beetle. Stands with basal area between 140 and 260 sq. ft. per acre are highly susceptible to beetle attack. Stands with basal areas between 80 and 120 are considered moderately hazardous, while stands less than 80 sq. ft. BA are considered to be at low risk for infestation. As stand density increases, the amount of competition between trees within the stand increases. This intense competition in high-density stands lowers a tree's resistance to beetle attack and represents a key feature in mountain pine beetle outbreaks (Sheppard and Battaglia 2002).

The ability of a tree to resist a mountain pine beetle attack has been linked to the amount of carbohydrates that can be utilized directly for defensive wound reactions. Environmental factors that restrict the size of a canopy or its photosynthetic efficiency weaken tree resistance. Drought can affect the carbon balance of a tree by halting photosynthesis, which depletes carbon reserves for defensive compounds and eventually reduces the size of the canopy. Tree vigor also decreases when live crown ration decreases to 30 % (Sheppard and Battaglia 2002).

Mountain pine beetle has always been a part of the Black Hills forest ecosystem, with outbreaks occurring periodically. There have been 5 or 6 major outbreaks of mountain pine beetles in the Black Hills over the past 100 years, each lasting about 10-15 years. Outbreaks of the beetle can cause considerable changes in forested stands, including a reduction in average stand diameter and density. Tree mortality levels of 25% can be expected throughout a landscape surrounding outbreak areas and levels of up to 50% or more can occur in heavily attacked stands (Allen et al. 2002).

The Beaver Park area and vicinity is currently experiencing a mountain pine beetle epidemic. The Beaver Park Roadless Area is outside the project area boundary, however this project area is adjacent to it on the north, west, and south sides. The number of trees killed per acre in Beaver Park is approaching totals that are above and beyond those reported for previous outbreaks in the Black Hills (Allen et al. 2002). Over 100 trees per acre have been killed in some parts of the Beaver Park area. A map in the Elk Bugs and Fuels Environmental Impact Statement Map Set displays the extent and intensity of mountain pine beetle caused mortality based on last years pest survey. Entire hillsides are now completely devoid of large trees. Many of the places that have the largest expanding populations are now outside of the Forbes Gulch area. Stand conditions in areas that have not already been affected by beetles remain conducive to sustaining high levels of beetle caused mortality. Those areas starting to decline in beetle infestation are those where most or all of the forest has already been killed (Allen et al. 2002). Beetles are starting to move out into surrounding Forest lands in the area. Places such as Vanocker Canyon, Park Creek, and Elk Creek Canyon are becoming heavily infested (Allen et al.). The project area is a mosaic of National Forest and lands of other ownership. Beetle caused mortality is occurring on National Forest and lands of other ownership

Ponderosa pine stands in the project area have been classified for mountain pine beetle risk. Stand susceptibility to beetle caused losses has been reduced due to beetle caused mortality in areas such as Forbes Gulch and Beaver Gulch, which are within the Beaver Park Roadless area. Stand hazard ratings give an indication of which stands are most likely to have initial beetle infestations. These ratings give no indication of local beetle pressure. Once an outbreak has started, any stands containing suitable host material are at risk (Allen et al. 2002).

**Table 64- Risk of Mountain Pine Beetle Caused Losses in Pine Stands
(RMSTAND; GIS acres)**

| Risk Rating | Acres (% of pine stands) |
|--------------------|---------------------------------|
| No Rating (0) | 1,583 (4%) |
| Low (1) | 14,133 (34%) |
| Medium (3) | 15,745 (38%) |
| High (5) | 10,161 (24%) |

The red turpentine beetle (*Dendrocoonus valens*) attacks the base of trees and freshly cut logs and stumps of ponderosa pine. It is a native bark beetle. It is not an aggressive tree killer, but frequently weakens trees, making them susceptible to other bark beetles. Population may increase where logging has occurred for several consecutive years (Sheppard and Battaglia 2002). Turpentine beetle populations are endemic across the project area and associated mortality is limited.

The pine engraver beetles (*Ips spp.*), native to the Black Hills, are potentially destructive in sapling and pole stands, although they are normally secondary insects. Pine engraver populations commonly develop in logging slash, especially if it is shaded or does not dry out quickly, or trees damaged by wind and snow. Fire scorched trees that still have suitable phloem are frequently attacked. Mortality in live trees is usually limited and risk is highest for trees 2-8 inches in diameter. Large trees that are attacked are often top killed by the pine engravers, while the lower bole is infested by other insects (Sheppard and Battaglia 2002).

Red rot (*Dichomitus squalens*), which causes a white-pocket rot, is one of the major causes for loss of sound wood in commercial stands. Both immature and mature, and vigorous and declining trees are susceptible to infection. The rot usually enters the tree through dead, bark covered branches (Alexander 1987). Red rot is common in stands throughout the project area, and the level of rot may be increasing due to snow damage to branches of live trees.

Western gall rust (*Endrocronarium harknessii*) can be found in ponderosa pine stands, however it is not a significant cause of tree mortality or deformity. Gall rust cankers kill branches, deform trees, and affect growth rates (Alexander 1987). Two areas of the project area have relatively high levels of trees infested with gall rust: windy flats, in the southwest portion of the project area, and stands originating after the Big Elk Burn, in the southeast portion of the project area.

Shoestring root rot (*Armillaria*) is present in the project area. Research shows that *Armillaria* may make ponderosa pine susceptible to mountain pine beetle infestations (Alexander 1987). This association is probably true on the project area, as mountain pine beetle infested trees can be found in areas of shoestring root rot.

Wind and Snow

Ponderosa pine has a well-developed root system and is one of the more wind-firm species in the Rocky Mountains. Although wind is not a primary cause of damage, it can be damaging locally, especially in mature to over-mature stands during windstorms accompanied by heavy, wet snow (Alexander, 1987). Snowstorms in the fall of 1982, fall of 1998, and spring of 1999 caused considerable damage and mortality in ponderosa pine stands throughout the northeastern Black Hills. The heavy snow combined with wind resulted in broken treetops, and branches, bent sapling and pole size trees, and toppled trees.

Snags

The following table displays the average number of ponderosa pine snags per acre, 10 inches in diameter or greater, by aspect, in stands of ponderosa pine cover-type throughout the thirteen 7th order watersheds associated with the project area. The snag densities were calculated from RMRIS tree data. Ponderosa pine snags with a diameter greater than 9.9 inches were calculated for each watershed and aspect based on RMRIS tree data. Tree status of M, S, or D, diameter greater than 9.9 inches, and watershed total was calculated by a summation of TALLY*TREE_FACTOR*Ris_acres (USDA Forest Service 1998). Stands with no tree data were assumed to have no snags. Information regarding snag height is not available, and live trees with snag characteristics are not included.

Table 65– Existing Pine Snags, 10” DBH and Larger (RMRIS Tree Data)

| Watershed | Aspect | Snags/Acre |
|------------------|---------------|-------------------|
| 10120202060202 | North | 1.0 |
| | South | 1.83 |
| 10120202020105 | North | 3.36 |
| | South | 3.29 |
| 10120202060105 | North | 0.60 |
| | South | 1.18 |
| 10120202060106 | North | 2.27 |
| | South | 4.29 |
| 10120202060104 | North | 2.74 |
| | South | 2.39 |
| 10120202060103 | North | 3.01 |
| | South | 2.97 |
| 10120202070101 | North | 6.04 |
| | South | 5.21 |
| 10120111020301 | North | 2.87 |
| | South | 2.52 |
| 10120202060102 | North | 4.95 |
| | South | 3.06 |
| 10120111020103 | North | 1.78 |

| Watershed | Aspect | Snags/Acre |
|------------------|---------------|-------------------|
| | | 2.32 |
| 10120111020305 | North | 2.42 |
| | South | 2.06 |
| 10120202060202 | North | 1.08 |
| | South | 0.77 |
| 10120111020104 | North | 1.27 |
| | South | 1.66 |

Most watersheds do not meet Forest wide Standard 2301 for the number of snags 10” and greater. Watersheds 10120202070101 and 10120202060102 meet the Forest wide Standard 2301 for the number of 10”. The watershed snag estimates are conservative, because they do not include recent mortality due to mountain pine beetle, or live trees with snag characteristics. In addition, there is a high probability that sites with no tree data have snags. In recent years there has been mountain pine beetle caused mortality across the entire project area, and beetle mortality is considered epidemic in the Beaver Park Roadless Area vicinity, including watersheds 10120202060106, 10120202070101, 10120111020301, 10120111020103, and 10120111020305.

Past and Planned Harvest

The district RIS database identifies forty-one timber sales within the Elk bugs and fuels project area since 1982. Timber harvest took place prior to 1982, but there are no records available. The following Table 66 shows the sale name and approximate years of harvest activity. Sales that are a result of recent legislation, Public Law 107-206 are not included. Salvage sales in the early 1980s harvested timber damaged during a snowstorm that occurred Columbus Day weekend, 1982.

Table 66- Recent Timber Sales Within Elk bugs and fuels Project Area

| Sale Name | Years of Harvest Activity | Sale Name | Years of Harvest Activity |
|------------------------|----------------------------------|------------------|----------------------------------|
| Chicken | 1982-1984 | Tilford | 1986-1993 |
| Spring Run Salvage | 1982-1983 | Monument | 1986 |
| Polo Salvage | 1982 | Nasty | 1986-1988 |
| Hill Salvage | 1983 | Runkle | 1986-1987 |
| Rooster Salvage | 1983 | Kelly | 1986-1990 |
| Three Draws Salvage | 1983 | Dalton | 1986 |
| Virkula Salvage | 1983 | Hay | 1989-1991 |
| Tilford Salvage | 1983 | Lost | 1989-1994 |
| Pullet Salvage | 1983 | Pit Resale | 1991-1992 |
| Cave Salvage | 1984 | Cave | 1992-1996 |
| Crook Mountain Salvage | 1984 | Vanocker | 1994-2000 |
| Left Salvage | 1984 | Roost | 1994-1997 |

| Sale Name | Years of Harvest Activity | Sale Name | Years of Harvest Activity |
|--------------------|---------------------------|-----------|---------------------------|
| Lost Salvage | 1984 | Boomer | 1997-2000 |
| Park Creek Salvage | 1985-1987 | Deadman | 1997-2001 |
| Pigtail Salvage | 1985-1986 | Kirk | 1998-present |
| Red Hill | 1985-1987 | Pit | 1998 |
| Kirk Hill | 1985 | Piedmont | 1999-present |
| Pine | 1985 | Boulder | 2001-present |
| Polo | 1985 | Redhill | 2002-present |
| Chicken Bugs | 1985 | Dano | 2002-present |
| Sid Bugs | 1985 | | |

Table 67 lists the acres of vegetation treated in timber sales in the 1980s, 1990s, 2000s, and recently planned timber sales. This table does not include treatments planned and implemented under recent legislation, P.L. 107-206.

Table 67- Acres of Vegetation Treatment; 1980s - Planned (RMRIS data)

| Treatment Code | Treatment Description | 1980s | | 2000s | Planned |
|----------------|---|--------------|-------------|----------|------------|
| 4111 | Clearcut | 182 | 239 | 32 | 76 |
| 4121/4122 | Shelterwood preparation | 0 | 0 | 90 | 0 |
| 4131 | Shelterwood seedcut | 646 | 1749 | 100 | 188 |
| 4141-4143 | Shelterwood removal and overstory removal | 143 | 629 | 45 | 307 |
| 4152 | Uneven-aged management – group selection | 0 | 0 | 0 | 16 |
| 4220 | Thin | 8,840 | 3,634 | 51 | 7 |
| 4230 | Salvage | 1,700 | 0 | 0 | 0 |
| 4240 | Special cut (aspen, aspen/birch maintenance and enhancement | 0 | 0 | 50 | 58 |
| 4511/4521 | TSI – Precommercial thinning | 1,344 | 2,144 | 218 | 74 |
| 6104 | Habitat improvement - tree encroachment control | 0 | 0 | 13 | 264 |
| 6108 | Regenerate aspen – clearcut | 458 | 356 | 7 | 54 |
| 6109 | Tree encroachment control | 0 | 321 | 40 | 103 |
| | Total Acres Treated by Decade (% of Forested Area) | 13,313 (30%) | 9,072 (21%) | 646 (1%) | 1,147 (3%) |

Grizzly Gulch Fire

The Grizzly Gulch Fire of June and July of 2002 burned 11,589 acres of which 3,315 are National Forest. Almost half of this fire, 5,608 acres, burned within the Elk Bugs and Fuels project boundary; 3,025 acres of National Forest lands and 2,583 acres of other ownership. National Forest lands within the project area that burned were mostly forest vegetation, with ponderosa pine, aspen, or aspen-birch cover types. Vegetation mortality

followed levels of fire severity. Mortality of trees on National Forest lands within the project area was mostly low to moderate, with high mortality, greater than 60%, on approximately 240 acres (Garbish, B 2002). Areas of high mortality were pine stands on steep, rugged slopes with little or no past treatment. No commercial timber salvage is planned on National Forest lands.

Logging Systems

The project area would be planned for harvest with conventional, ground based harvest operations and skyline yarding. Conventional harvest equipment operations would be hand felling with chainsaws and the use of rubber tired skidders to yard wood to the landing, where it would be bucked to length and loaded on trucks for transport to the mill. Unless expressly prohibited, other ground based logging systems would be acceptable, including mechanical felling with equipment such as tracked feller-bunchers, and cut-to-length systems. Skyline yarding brings logs to a road by means of a suspended cable system. Skyline yarding is typically used in areas with slopes greater than 35%. Road systems for skyline yarding need to be well placed to access the timber, and logs are usually pulled uphill.

Environmental Consequences:

Direct and Indirect Effects

Alternatives 1, 2, 3, and 4

Forest Insects

Chances for pine engraver beetle caused mortality would increase with all alternatives. Pine engraver beetle's primary host is fresh slash, wind-thrown trees (Sheppard and Battaglia 2002), fire-killed trees, and the treetops of mountain pine beetle killed trees (Allen, K. personal communication.). Depending on weather conditions and the continuity of harvest and post-treatment operations, a large population of beetles could build up in slash. Stressed trees could be successfully attacked. Proper slash treatment and timing of post-sale treatments in alternatives 2, 3, and 4, would minimize losses and the pine engraver beetle would not pose a problem (Allen, K. personal communication.). Slash treatments which minimize build-up of beetle populations include: limb and lop slash to less than 18" depth, whole-tree-yarding, and breaking the continuity of vegetation treatments to break the "green chain" or supply of suitable bark beetle habitat. The biggest producers of pine engraver beetles are those trees infested by mountain pine beetle. Treatments that lower mountain pine beetle risk and treat beetle-infested trees would decrease pine engraver beetle populations, even if they create slash (Allen, K. personal communication.).

Proposed treatments in Alternatives 2, 3, and 4, would decrease the risk of mountain pine beetle caused losses in ponderosa pine stands. Risk of mountain pine beetle caused losses could continue with Alternative 1 until beetle caused mortality decreases suitable habitat. There are large populations of mountain pine beetles in the project area and vicinity, and suitable habitat to sustain beetle populations.

Stands are considered to be most susceptible to mountain pine beetle caused losses when 75% of the stand is in the 7-13 inch diameter range and stand density is over 120 feet of basal area per acre (Stevens et al. 1980, Schmid and Mata 1992). Stand risk ratings are based on stand structure, average stand diameter, and stand density. High-risk stands are single storied, have a large average diameter, and high density. Stand hazard ratings give an indication of stands most likely to have initial beetle infestations. Once an outbreak has started, any stands containing suitable host material are likely to incur damage. The reduction of risk in stands is temporary, and risk increases with stand growth. Thinned stands can be expected to reach the high-risk category in 13-50 years (Obedzinski et al. 1999) depending on the residual stocking and site quality. The following table displays the post treatment risk rating of ponderosa pine stands. Risk was calculated using the RMSTAND program for stands with tree data. Recently treated stands and stands planned for treatment were rated based on estimated stand structure, average tree diameter, and stand density, following guidelines from the Rocky Mountain Forest and Range Experiment Station (Stevens, et al. 1980).

Table 68 Post-Treatment Mountain Pine Beetle Risk

| Risk Rating | Post-treatment Risk – Acres (% of PP Covertypes) | | | |
|-------------|--|--------------|--------------|--------------|
| | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 4 |
| Low | 16,464 (40%) | 17,274 (42%) | 16,692 (40%) | 17,303 (42%) |
| Moderate | 16,219 (40%) | 16,683 (40%) | 17,190 (41%) | 16,677 (40%) |
| High | 8,941 (21%) | 7,667 (18%) | 7,742 (19%) | 7,644 (18%) |

Alternative 4 best reduces the risk of mountain pine beetle caused losses in ponderosa pine stands across the project area followed by Alternatives 2 and 3.

Sanitation of beetle-infested trees would occur in stands planned for commercial timber harvest. Beetle infested trees would be cut, removed, and debarked at a sawmill, killing the beetle population within the tree. This treatment can reduce mountain pine beetle populations in localized areas and individual stands, and provide some protection to surrounding trees and stands by removing a large source of attacking beetles (Allen and Long 2001). Sanitation would increase the likelihood of post-treatment stand stocking remaining at desired levels. Alternative 4 would treat the most area with sanitation and would be the most effective at reducing beetle populations in the project area, followed by Alternatives 2 and 3. Alternative 1 would do nothing to reduce beetle populations in the project area.

Bait and sanitation treatments would occur in Alternatives 2 and 4 at 8 locations. Mountain pine beetles in a local area would be concentrated using pheromone bait and destroyed through sanitation timber harvest. The baited tree and surrounding trees would be attacked. This treatment could reduce mountain pine beetle populations in localized areas and individual stands, and provide some protection to surrounding trees by removing a source of beetles. Bait and sanitation treatments would be more efficient than sanitation alone because the infested trees would be localized to facilitate their removal.

Mountain pine beetle caused mortality would likely continue in all alternatives, especially in dense, untreated pine stands. Mortality could be intense and extensive in these stands. Mortality in surrounding treated areas, should be less in Alternatives 2, 3, and 4 due to sanitation treatments which decrease beetle populations, and thinning which decreases stand risk. Alternative 4 would do the most to decrease mountain pine beetle caused mortality, followed by Alternatives 2 and 3.

Harvest Volume

Harvest volume for the alternatives is displayed in the following Table . The volumes are estimates based on stand exam data. Alternative 4 would harvest the most sawtimber and POL (products other than logs), followed by Alternative 2 and 3.

Table 69- Harvest Volume by Alternative

| Product | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 4 |
|-----------------------|---------------|---------------|---------------|---------------|
| Net Sawtimber – CCF | 0 | 20,700 | 15,400 | 21,300 |
| Net POL – CCF | 0 | 14,500 | 9,700 | 14,900 |
| Total Net Volume- CCF | 0 | 35,200 | 25,100 | 36,200 |

The following table displays each alternative's harvest volume contribution to the forest Allowable Sale Quantity (ASQ) and non-ASQ volume from lands classified as tentatively suitable and unsuitable. Timber harvest is planned on lands classified as tentatively suitable and unsuitable. Harvest on these lands is not for timber commodity purposes; harvest would achieve other land management objectives: wildland fuel abatement and forest insect control.

Table 70- ASQ Volume by Alternative

| | Product | Net CCF Volume | | |
|---------|----------------|-----------------------|---------------|--------|
| | | Alt. 2 | Alt. 3 | |
| ASQ | Sawtimber | 16,100 | 11,100 | 16,700 |
| | Roundwood | 10,300 | 7,100 | 10,600 |
| Non-ASQ | Sawtimber | 4,600 | 4,300 | 4,600 |
| | Roundwood | 4,200 | 2,600 | 4,300 |

Stand Structure and Stocking

Stand structure could gradually change through time in Alternative 1 or stand structure could change drastically due to mountain pine beetle mortality. Stands would continue to grow and increase in stocking. Mortality would occur in overstocked stands due to tree-tree competition, insect and disease caused mortality, and weather events such as windy, wet spring snowstorms. Beetle caused mortality could be extensive and light, with only a few trees killed per acre in any year, or mortality could be intensive, with stand mortality in the range of 50-100% of standing trees in areas several hundred acres in size. Stands with moderate to high beetle mortality would regenerate to pine, forming 1-3 storied stands, depending on overstory mortality. Hardwood stands and inclusions would continue to decline as ponderosa pine trees seed into hardwood stands and grow. Hardwoods would increase in areas with moderate to heavy mountain pine beetle mortality, especially on north slopes and along drainages.

The treatments proposed in Alternatives 2, 3, and 4 would change stand structures, dependent on the treatment. All proposed treatments would reduce the stocking of ponderosa pine, and increase hardwoods.

Table 71 Post Treatment Ponderosa Pine Stocking

| Stocking | Alt. 1 Acres | Acres | Alt. 3 Acres | Alt. 4 Acres |
|-----------------|-------------------------|--------------|-------------------------|-------------------------|
| 0-39 % AMD | 13,856 | 17,922 | 17,209 | 18,388 |
| 40-59 % AMD | 14,474 | 11,707 | 12,482 | 11,434 |
| 60+ % AMD | 13,290 | 11,993 | 11,931 | 11,851 |

Thinning from below would reduce stocking of ponderosa pine stands. The largest trees with the best phenotype would remain and continue to grow. Stands would be more open, and there would be fewer small diameter stems. Alternatives 2 and 4 would thin stands to 80 sq. feet basal area, or ½ of their existing stocking, whichever is less. Alternative 3 would thin stands to 60-70 sq. ft. of basal area. Alternative 2 would thin 8,058 acres, Alternative 3 would thin 6,656 acres, and Alternative 4 would thin 8,381 acres. Thinned stands would appear as a forest of trees, however they would be fairly open, and most tree crowns would not be touching. Following harvest, thinned stands would appear fairly uniform in stocking, however stocking would vary within stands due to past disturbances such as areas of insect or disease caused mortality, or mortality due to weather. With time, within stand variation of stocking would increase due to variations in site quality and corresponding tree growth, and mortality due to insects, disease, and weather. Hardwoods, such as aspen and birch, present in the understory of thinned stands, would release, and coppice sprouts would be common, especially on moist north and east slopes.

The creation of shaded fuel breaks in Alternatives 2, 3, and 4 would also reduce the stocking of ponderosa pine stands. Treatments to create shaded fuel breaks would remove the smaller pines, and the largest trees with the best phenotype would remain and continue to grow. Patches of hardwood trees would have most of the pine removed. These stands would be more open than the thinned stands, and inclusions or pockets of hardwoods would be more evident. Alternatives 2, 3, and 4 would create 1,635 acres of shaded fuel breaks.

Hardwood restoration treatments would reduce ponderosa pine stocking within pine/aspen, pine/oak, and pine/aspen/birch stands through commercial harvest and non-commercial treatment areas. Reducing pine stocking slows the natural succession from hardwoods to pine, and decreases competition for light and nutrients. This improves the health and growth of the existing oak, aspen, or aspen/birch. Following treatment, hardwoods would be the dominant trees in these stands, with scattered mature and over-mature pines. Alternatives 2, 3, and 4 would treat 323 acres of hardwoods.

Burning is planned within the project area in alternatives 2, 3, and 4. Burning pine and mixed pine/hardwood stands would change stand structure. The proposed low-intensity underburning would kill most pine seedlings, with mortality decreasing with tree size. Underburning would also kill hardwoods, including oak, aspen, and birch, however these species would quickly sprout new stems from their existing roots. Seedlings may also sprout in the exposed mineral soil. Pine stands would appear more open and uniform in tree size after burning, except where hardwoods exist. Where hardwoods exist, stand structure would increase. Alternative 3 proposes burning in 4,423 acres of pine covertime and alternative 4 proposes to burn 2,516 acres of pine covertime.

Burning hardwood stands would kill most standing, live trees. Oak, aspen, and birch would quickly sprout new stems and stands would appear as a dense stand of saplings, with scattered pines, within 1-3 years of the burn. Alternative 2 would underburn 87 acres of mixed birch and pine, Alternative 3 would underburn 174 acres of hardwoods and 3,032 acres of pine, Alternative 4 would underburn 175 acres of hardwoods.

Burning is also planned in meadows or grasslands where pine seedlings are common. Burning should kill a large number of these seedlings, and maintain the areas as grass. Alternative 2 would burn 252 acres of grasslands or meadows, Alternative 3 would burn 255 acres, and Alternative 4 would burn 252 acres.

Bait and sanitation treatments in Alternatives 2 and 4 would create openings within forested stands, 1/10 to several acres in size. These openings would reforest naturally, with seed from adjacent trees, within 5 years.

Beetle caused mortality would likely occur, especially in stands with high risk, as a large mountain pine beetle populations exists in the area. Stands with moderate to high beetle

caused mortality would regenerate and become 1-3 storied stands. Stand structure changes due to beetle caused mortality would be expected to be less in Alternatives 2, 3, and 4, as compared to Alternative 1.

Even-aged Management of Ponderosa Pine

The use of even-age management is appropriate to meet the objectives of the Black Hill National Forest Land and Resource Management Plan. The preferred silvicultural system for regenerating ponderosa pine on suitable lands is shelterwood (USDA Forest Service 1997).

Restocking Within Five Years

All stands proposed for silvicultural treatment can be adequately restocked within five years of final harvest. Stands in the vicinity with comparable site conditions have received similar silvicultural treatment and resulted in full stocking within five years of final harvest.

Culmination of Mean Annual Increment (CMAI)

Stands proposed for thinning, fuel breaks, sanitation, patch cuts, and hardwood restoration were not evaluated for culmination of growth. These practices are not subject to the CMAI findings because the treatments are exceptions permitted as sound silvicultural practices or meet multiple use objectives (36 CFR 219.16(2)(iii)).

Stand Diversity

Natural succession and events such as wildfire, weather, and insects would determine stand diversity in Alternative 1. Without disturbance, age-class distribution of ponderosa pine stands would continue to move towards maturity and away from younger stages. Hardwood stands and inclusions would continue to decrease due to natural succession to ponderosa pine. White spruce would continue to increase on sites where it is climax. Pine trees would continue to encroach on grasslands, reducing diversity in the project area.

Low to moderate levels of mountain pine beetle caused mortality would increase stand diversity by creating small openings. Stands with high levels of beetle caused mortality would regenerate and create stand age-class diversity. Beetle caused mortality could reduce stand diversity, where mortality is high, over a large area. Large areas could regenerate to a single age-class of pine and result in stand conditions suitable for future mountain pine beetle outbreaks.

Alternatives 2, 3, and 4 are more likely to maintain beetle caused mortality at *endemic* levels that increase within-stand diversity. Thinning to decrease stand risk and sanitation to decrease beetle populations are likely to maintain beetle caused mortality as individual trees and small patches at the local level.

The within-stand diversity of ponderosa pine stands where hardwoods are present would increase through thinning and burning in alternatives 2, 3, and 4. Thinning and burning would stimulate coppice hardwood regeneration. While aspen, birch, and oak grow best in full sun, these species would sprout and survive in the understory and midstory of thinned or burned stands. Within stand diversity would decrease in pine stands with few or no hardwoods. Thinned or burned pine stands would appear more even-aged because there would be fewer understory trees.

The within stand diversity of pine stands with a white spruce component would decrease in alternatives 2, 3, and 4. While no stands with a spruce cover type would be treated, some stands proposed for treatment have spruce trees. Thinning (from below), fuel break treatments, and prescribed burning would kill or remove most white spruce seedlings, saplings, and pole size trees. Following treatment, these stands would be composed of mostly pine trees, or pine and hardwoods. Alternatives 2 and 4 would treat 496 acres where spruce could become the dominant species with no disturbance, and Alternative 3 treats 335 acres.

Alternative 2, 3, and 4 would maintain 323 acres of hardwoods through the removal of conifers. Removing the conifers would slow the succession from hardwoods to pine and spruce. Maintaining hardwoods on these sites would maintain diversity across the project area.

Ponderosa pine trees are growing within and seeding adjacent meadows. Burning the meadows would reduce pine encroachment. Alternatives 2 and 4 would burn 252 acres of grass covertype and alternative 3 would burn 255 acres. Alternative 3 would take additional steps to decrease pine encroachment on grasslands. Pine seedlings, saplings, and pole size trees growing in meadows would be cut and slashed to maintain the area as grassland. Alternative 3 would treat pine within 170 acres of grasslands or mixed forest-grasslands. Alternative 3 would do the most to maintain meadows and grasslands, followed by alternatives 2 and 4.

Cumulative Effects

The area to be analyzed for cumulative effects is the eighteen 7th order watersheds that encompass the project area and activities undertaken due to Public Law 107-206. Cumulative actions will be analyzed in three parts: cumulative actions within the project area, cumulative actions outside the project area (within the eighteen 7th order watersheds), and snags and green tree retention, which will be analyzed on a watershed-by-watershed basis. Silvicultural treatments generally have minimal direct affect on adjacent stands and even less effect on stands in adjacent watersheds, other than indirect effects such as habitat for mountain pine beetle populations. Revised Forest Plan Standards 2301, 2302, and 2306 require analysis of snags and green tree retention on a watershed basis, so the eighteen watersheds that encompass the project area and activities undertaken due to Public Law 107-206 will be the area of analysis.

Project Area Cumulative Effects

The project area includes 44,766 acres of National Forest land and 15,605 acres of other ownership. Past actions to be analyzed for cumulative effects include those since settlement in the late 1800s. Reasonably foreseeable actions include those currently planned or actions that could be expected to happen within the next 20 years.

Past Actions

Past actions in the project area on National Forest, private, and other lands include timber harvest, wildland fuel management, fire suppression, grazing, mining, gravel production, recreation, firewood cutting, big-game management, road construction, railroad construction, subdivision of private lands and home construction, utility line construction and maintenance.

Field reconnaissance shows timber harvest occurred throughout the project area since settlement in the late 1800s, however there are no records available for treatment prior to the 1980s. Harvest included green sawtimber trees and dead standing “pitch pine” which was used for fence posts. Recent National Forest timber sales, since 1982, within the project area are listed in the following table. Salvage sales in the early 1980s harvested timber damaged during a snowstorm that occurred Columbus Day weekend, 1982.

Table 72 Recent Timber Sales within Elk Bugs and Fuels Project Area

| Sale Name | Years of Harvest Activity | Sale Name | Years of Harvest Activity |
|------------------------|---------------------------|--------------------------|---------------------------|
| Chicken | 1982-1984 | Tilford | 1986-1993 |
| Spring Run Salvage | 1982-1983 | Monument | 1986 |
| Polo Salvage | 1982 | Nasty | 1986-1988 |
| Hill Salvage | 1983 | Runkle | 1986-1987 |
| Rooster Salvage | 1983 | Kelly | 1986-1990 |
| Three Draws Salvage | 1983 | Dalton | 1986 |
| Virkula Salvage | 1983 | Hay | 1989-1991 |
| Tilford Salvage | 1983 | Lost | 1989-1994 |
| Pullet Salvage | 1983 | Pit Resale | 1991-1992 |
| Cave Salvage | 1984 | Cave | 1992-1996 |
| Crook Mountain Salvage | 1984 | Vanocker | 1994-2000 |
| Left Salvage | 1984 | Roost | 1994-1997 |
| Lost Salvage | 1984 | Boomer | 1997-2000 |
| Park Creek Salvage | 1985-1987 | Deadman | 1997-2001 |
| Pigtail Salvage | 1985-1986 | Kirk | 1998-present |
| Red Hill | 1985-1987 | Pit | 1998 |
| Kirk Hill | 1985 | Piedmont | 1999-2000 |
| Pine | 1985 | Boulder | 2001-present |
| Polo | 1985 | Redhill | 2002-present |
| Chicken Bugs | 1985 | Dano | 2002-present |
| Sid Bugs | 1985 | Public Law 107-206 Sales | 2002-present |

Past, Present and Reasonably Foreseeable Activities

Table 73 lists the acres of vegetation treated in National Forest timber sales in the 1980s, 1990s, 2000s, recently planned timber sales, and treatments planned and implemented under recent legislation, P.L. 107-206.

Table 73 Acres of Vegetation Treatment within Elk Bugs and Fuel Project Boundary; 1980s - Planned (RMRIS data)

| Treatment Code | Treatment Description | 1980s | 1990s | 2000s | Planned |
|-----------------------|---|--------------|--------------|--------------|----------------|
| 4111 | Clearcut | 182 | 239 | 32 | 76 |
| 4121/4122 | Shelterwood preparation | 0 | 0 | 90 | 0 |
| 4131 | Shelterwood seedcut | 646 | 1749 | 100 | 188 |
| 4141-4143 | Shelterwood removal and overstory removal | 143 | 629 | 45 | 307 |
| 4152 | Uneven-aged management – group selection | 0 | 0 | 0 | 16 |
| 4220 | Thin | 8,840 | 3,634 | 51 | 3,975 |
| 4230 | Salvage | 1,700 | 0 | 0 | 0 |
| 4240 | Special cut (aspen, aspen/birch maintenance and enhancement | 0 | 0 | 50 | 58 |
| 4511/4521 | TSI – Precommercial thinning | 1,344 | 2,144 | 218 | 74 |
| 6104 | Habitat improvement - tree encroachment control | 0 | 0 | 13 | 264 |
| 6108 | Regenerate aspen – clearcut | 458 | 356 | 7 | 54 |
| 6109 | Tree encroachment control | 0 | 321 | 40 | 103 |
| | Total Acres Treated by Decade (% of Forested Area) | 13,313 (28%) | 9,072 (19%) | 646 (1%) | 5,115 (12%) |

Grizzly Gulch Fire

The Grizzly Gulch Fire of June and July of 2002 burned 11,589 acres of which 3,315 are National Forest. Almost half of this fire, 5,608 acres, burned within the Elk Bugs and Fuel project boundary; 3,025 acres of National Forest lands and 2,583 acres of other ownership. National Forest lands within the project area that burned were mostly forest vegetation, with ponderosa pine, aspen, or aspen-birch cover types. Vegetation mortality followed levels of fire severity. Mortality of trees on National Forest lands within the project area was mostly low to moderate, with high mortality, greater than 60%, on approximately 240 acres (Garbish, B 2002). Areas of high mortality were pine stands on steep, rugged slopes with little or no past treatment. No commercial timber salvage is planned on National Forest lands. Salvage is occurring on BLM managed lands and private lands.

Current Actions

Timber sales are currently under way on National Forest lands within the project area, and include Boulder, Redhill, Piedmont, Kirk, Cavern, Dano, and sales associated with Public Law 107-206. Livestock grazing occurs on National Forest and private land. Wildfires are suppressed. Subdivision and development of private land is taking place. Maintenance of roads, trails, and electric utility lines continues. Recreational activities include sightseeing, biking, use of all-terrain vehicles, and hunting. The State of South Dakota manages big game populations through regulated hunting.

Future Actions

Reasonably foreseeable future actions include continued development of private land, vegetation management on Federal and private lands, road and utility corridor maintenance, livestock grazing, wildfire suppression, wildland fuel management, recreation, and big-game management. Future timber sales and associated fuel treatments and non-commercial vegetation management in the vicinity include the Mineral Timber Sale scheduled for sale in 2004, the Jimmy Timber Sale scheduled for 2004, the Strike Timber Sale scheduled for 2004, and the Lead-Deadwood Exemption Area Wildland Urban-Interface (WUI) Project. These sales and projects would have units in watersheds adjacent to the cumulative effects area.

Effects

Historically, wildfire was a keystone ecological process that shaped the composition and structure of plant communities in the Black Hills. Over the past 100 years fire has been suppressed. Forest density has changed markedly in many Black Hills landscapes as a result of fire suppression. In the past, periodic surface fire consumed small seedlings, pruned lower branches, and consumed concentrations of woody fuels on the forest floor. If, or when large crown fires did occur, they probably did not completely consume all trees within a landscape, but left some sources of seed for the eventual reforestation of the burned area. The result was a mosaic of conditions ranging from openings to groups of young seedlings to clumps and groups of older trees, including large orange-barked patriarchs (Sheppard and Battaglia 2002).

Forest vegetation has been altered since settlement in the 1870's through timber harvest, fire suppression, wildfire, mining, and grazing by livestock. The age-classes of ponderosa pine stands in the project area show that approximately 63% of the stands originated between 1880 and 1919. This was likely the result of a combination of wildfire, mountain pine beetle, and logging. Timber harvest, mountain pine beetle, and wildfire suppression over the last 125 years are responsible for the structure, composition, and appearance of the existing forest. The project area is dominated by relatively dense ponderosa pine stands, with smaller areas of quaking aspen and birch. Timber harvest has repeatedly thinned pine stands, however tree growth has exceeded harvest. Regeneration harvest treatments, shelterwood seedcut and clearcut, have taken place on less than 8% of pine stands since 1980, leaving a preponderance of similar age-class pine. Hardwoods are common in the understory of pine stands on north aspects. In general,

more of the area is now forested with ponderosa pine, and less is forested with aspen and birch, there is less grassland, and the ponderosa pine is smaller. Browsing of hardwood sprouts by cattle and big game has contributed to a decrease in the presence of hardwoods. (Sheppard and Battaglia 2002)

Firewood cutting in this area is common due to the close proximity to local communities. Due to logging residue and storm damage there has been an ample supply of firewood. Firewood cutting is now restricted to dead and down timber. Due to these factors, firewood cutting has had a minimal effect on existing snags.

Mining for gravel removed forest vegetation from several sites, which total approximately 10 acres. The windy-flats gravel pit has been abandoned and trees are taking over the site. The Virkula gravel pit is still active, however once gravel operations are completed, trees will take over the site. There should be no long-term effects on forest vegetation due to gravel pits.

The construction and maintenance of roads, recreation trails, and utility lines across the area has decreased the forested area. Maintenance crews routinely cut down trees growing up in utility and road corridors. These sites will not produce large trees or harvest volume as long as the corridors are maintained. The forest area in these corridors is very small and once abandoned, trees will seed-in and once again occupy the site so there should be no long-term effects on forest vegetation due to road, trail, and utility corridors.

Recreational activities have little or no effect on forest vegetation, other than the road and trail corridors previously discussed.

The development of private lands adjacent to forest stands have no direct effects on forest stands other than those associated with utility corridors. These lands will likely be managed to minimize wildfire risk. Stands with low-wildfire risk would be more characteristic of stands prior to settlement, when periodic low-intensity surface fire consumed wildland fuels. There should be no effects on forest vegetation that are outside of historic conditions.

Alternative 1

In the absence of treatment or wildfire, stands throughout the area would follow the successional trend toward increased composition of ponderosa pine, except in areas of moderate to high mountain pine beetle caused mortality. The area in hardwood cover type and hardwood inclusions would decrease as ponderosa pines seed-in and grow. Browsing of hardwoods would contribute to the decline of hardwoods in the area. Openings in the pine forest due to weather events and insect caused mortality would maintain some hardwoods, however ponderosa pine would be likely to occupy these sites as a seed source for pine would be nearby.

Mortality due to mountain pine beetle would be difficult to predict, although as stand density increases across the project area, risk of mountain pine beetle caused losses would increase. Mortality would range from scattered individual trees, to patches of mortality several hundred acres in size. Large populations of mountain pine beetle are present and suitable beetle habitat exists in the project area and vicinity (Allen et al. 2002). Large areas of intense beetle caused mortality could occur, similar to areas in Forbes Gulch where intense mortality approaches 1,000 acres or more. Extensive low to moderate levels of beetle caused mortality is also likely.

Past and on-going management actions that have changed the mix of age-classes, decreased stand stocking, and improved species diversity would have some beetle caused mortality, however beetle caused mortality should not be as intense or extensive as in areas with no recent management activity. Recent activity includes timber sales within the last 10-20 years and activities due to Public Law 107-206.

The amount of Forest land within road, recreation trail, and utility line corridors would remain unchanged with Alternative 1.

Alternative 2, 3, and 4

Alternatives 2, 3, and 4 would decrease the density of pine stands across a portion of the area, removing smaller diameter pines, and would create a more open forest of large diameter trees. The remaining pine trees would continue to grow in height and diameter. Hardwoods would increase in the treated areas, and hardwood stands with overstory trees in decline would be more likely to successfully regenerate.

Risk of mountain pine beetle caused losses would decrease within the project area with all action alternatives, although stands would increase in susceptibility to attack with growth and no further treatment. In most cases, thinned stands would change from moderate risk to high risk within 10-20 years. Stands within the project area contain suitable habitat for mountain pine beetles. A mountain pine beetle epidemic could build in this habitat and spread to stands throughout the project area.

Management actions in Alternatives 2, 3, and 4 would change the mix of age-classes, density, species diversity, and remove a portion of the beetle population. These actions should decrease mortality in treated stands. More stands stocked with moderate densities of mid-age to mature pine would remain on the landscape, as compared to Alternative 1, should the beetle outbreak continue.

Management actions in Alternatives 2, 3, 4, and actions authorized by Public Law 107-206 are in proximity to private lands. Treatments reducing beetle populations and decreasing risk of infestation should decrease the spread of mountain pine beetles from public to private land.

Forestland within road, recreation trail, and utility corridors would decrease with Alternatives 2, 3, and 4 due to the overall reduction of roads within the project area. There would be a slight increase in the amount of productive forestland with all action alternatives. Alternative 3 would do the most to return lands to forest production followed by Alternatives 2 and 4.

Cumulative Effects of Public Law 107-206 Activities Outside the Project Boundary

The cumulative effects area outside the project boundary includes 45,642 acres of National Forest land and 6,124 acres of other ownership. This area includes the Beaver Park Roadless Area and Surrounding Area described in Civil Action No. 99-N-2173 Settlement Agreement, Exhibit A2, and an additional five 7th order watersheds, which encompass activities undertaken due to Public Law 107-206.

Past actions to be analyzed for cumulative effects include those since settlement in the late 1800s. Reasonably foreseeable actions include those currently planned or actions that could be expected to happen within the next 20 years.

Past Actions

Past actions in the project area include timber harvest, silvicultural treatments, wildland fuel management, fire suppression, grazing, mining, gravel production, recreation, firewood cutting, big-game management, road construction, railroad construction, subdivision of private lands and home construction, utility line construction and maintenance.

Field reconnaissance shows timber harvest has occurred throughout the cumulative effects area since settlement in the late 1800s, however there are no records available for treatment prior to the 1980s. Harvest included green sawtimber trees and dead standing “pitch pine” which was used for fence posts. National Forest timber sales since 1982, within the project area are listed in the following table. Salvage sales in the early 1980s harvested timber damaged during a snowstorm that occurred Columbus Day weekend, 1982.

Table 74 Recent Timber Sales within Elk Bugs and Fuels Cumulative Effects Area and Outside the Project Area

| Sale Name | Years of Harvest Activity | Sale Name | Years of Harvest Activity |
|------------------|----------------------------------|------------------|----------------------------------|
| Benchmark | 1979-1986 | Hay | 1989-1991 |
| Stagebarn | 1981-1989 | Lucky | 1989-1993 |
| Airport Salvage | 1982 | Novak | 1991-1993 |
| Greenwood | 1982 | Pit Resale | 1991-1992 |
| LS Salvage | 1984 | Greenmont | 1991 |

| Sale Name | Years of Harvest Activity | Sale Name | Years of Harvest Activity |
|------------------|----------------------------------|--------------------------|----------------------------------|
| Wilson Salvage | 1984 | Cave | 1992 |
| Erskine | 1985 | Flagstaff | 1992-1993 |
| Lucky East Bugs | 1985 | Dump | 1993 |
| Lucky West Bugs | 1985 | Greenwood | 1996 |
| Dalton | 1986-1993 | Bench | 1997 |
| Kelly | 1986-1990 | Kine | 1997-1998 |
| Skislide | 1988-1991 | Kirk | 1998-present |
| Wilson | 1988 | Cavern | 1999-present |
| Misty | 1989-1990 | Public Law 107-206 Sales | 2002-present |

Table 75 lists the acres of vegetation treated in National Forest timber sales in the 1980s, 1990s, 2000s, recently planned timber sales, and treatments planned and implemented under recent legislation, P.L. 107-206.

Table 75 Past and Planned Silviculture Treatments (RMRIS Data)

| Treatment Code | Treatment Description | 1980s | 1990s | 2000s | Planned |
|-----------------------|--|--------------|--------------|--------------|----------------|
| 4111 | Clearcut | 117 | 109 | 0 | 259 |
| 4121 | Shelterwood preparation | 0 | 13 | 0 | 0 |
| 4131 | Shelterwood seedcut | 743 | 1843 | 0 | 26 |
| 4141-4143 | Shelterwood removal and overstory removal | 233 | 765 | 252 | 805 |
| 4152 | Uneven-aged management – group selection | 0 | 0 | 0 | 128 |
| 4220 | Thin | 9,265 | 4,500 | 78 | 5,481 |
| 4230 | Salvage | 1,261 | 0 | 0 | 0 |
| 4511/4521 | TSI – Precommercial thinning | 3,903 | 4,356 | 506 | 0 |
| 6104 | Habitat improvement – tree encroachment control | 0 | 41 | 0 | 217 |
| 6108 | Regenerate aspen – clearcut | 39 | 157 | 0 | 148 |
| 6109 | Tree encroachment control | 0 | 31 | 91 | 0 |
| | Forbes Gulch Fuel Treatments | | | | 700 |
| | Beaver Park – Forest Boundary Fuel Break | | | | 117 |
| | | | | | |
| | Total Acres Treated by Decade (% of Forested Area) | 15,561 (35%) | 11,815 (26%) | 927 (2%) | 7,881 (18%) |

Current Actions

Timber sales are currently under way on National Forest lands within the cumulative effects area and outside the project area; including Kirk, Cavern, and sales associated with Public Law 107-206. Livestock grazing occurs on National Forest and private land. Wildfires are suppressed. Subdivision and development of private land is taking place. Maintenance of roads, trails, and electric utility lines continues. Recreational activities include sightseeing, biking, use of all-terrain vehicles, and hunting. The State of South Dakota manages big game populations through regulated hunting.

Future Actions

Reasonable foreseeable future actions include continued development of private land, vegetation management on Federal and private lands, road and utility corridor maintenance, livestock grazing, wildfire suppression, wildland fuel management, recreation, and big-game management. Future timber sales and associated fuel treatments and non-commercial vegetation management in the vicinity include the Jimmy Timber Sale, and the Strike Timber Sale, both scheduled for 2004. These sales would have units in watersheds adjacent to the cumulative effects area.

Effects

Historically, wildfire was a keystone ecological process that shaped the composition and structure of plant communities in the Black Hills. Over the past 100 years fire has been suppressed. Forest density has changed markedly in many Black Hills landscapes as a result of fire suppression. In the past, periodic surface fire consumed small seedlings, pruned lower branches, and consumed concentrations of woody fuels on the forest floor. If, or when large crown fires did occur, they probably did not completely consume all trees within a landscape, but left some sources of seed for the eventual reforestation of the burned area. The result was a mosaic of conditions ranging from openings to groups of young seedlings to clumps and groups of older trees, including large orange-barked patriarchs (Sheppard and Battaglia 2002).

Forest vegetation has been altered since settlement in the 1870's through timber harvest, fire suppression, wildfire, mining, and grazing by livestock. The age-classes of ponderosa pine stands in this area are similar to the project area with most stands originating between 1880 and 1919. This was likely the result of a combination of wildfire, mountain pine beetle, and logging. Timber harvest, mountain pine beetle, and wildfire suppression over the last 125 years are responsible for the structure, composition, and appearance of the existing forest. The cumulative effects area is dominated by relatively dense ponderosa pine stands, with smaller areas of quaking aspen and birch. Timber harvest has repeatedly thinned pine stands, however tree growth has exceeded harvest. Regeneration harvest treatments, shelterwood seedcut and clearcut, have taken place on less than 7% of pine stands, leaving a preponderance of similar age-class pine. Hardwoods are common in the understory of pine stands on north aspects. In general, more of the area is now forested with ponderosa pine, and less is forested with aspen and birch, there is less grassland, and the ponderosa pine is smaller. Browsing of hardwood

sprouts by cattle and big game has likely decreased the presence of hardwoods (Sheppard and Battaglia 2002).

Firewood cutting in this area is common due to the close proximity to local communities. Due to logging residue and storm damage, there has been an ample supply of firewood. Firewood cutting is now restricted to dead and down timber. Due to these factors, firewood cutting has minimal effect on existing snags.

The construction and maintenance of roads, recreation trails, and utility lines across the area has decreased the forested area. Maintenance crews routinely cut down trees growing up in utility and road corridors. These sites will not produce large trees or harvest volume as long as the corridors are maintained. The forest area in these corridors is very small and once abandoned; trees seed-in and occupy the site so there should be no long-term effects on forest vegetation due to road, trail, and utility corridors.

Recreational activities have little or no effect on forest vegetation, other than the road and trail corridors previously discussed.

The development of private lands adjacent to forest stands have no direct effects on forest stands other than those associated with servicing utility corridors, however these lands will likely be managed to minimize wildfire risk. Stands with low-wildfire risk would be more characteristic of stands prior to settlement, when periodic low-intensity surface fire consumed wild land fuels. There should be no effects on forest vegetation outside of historic conditions.

Treatments in recent planned timber sales: Kirk, Cavern, Public Law 107-206 sales, and fuel treatments will decrease stocking across approximately 15% of the ponderosa pine cover-type. Treatments that regenerate aspen and pine will occur on less than 1% of the area. Mountain pine beetle sanitation will also occur in these projects. These treatments, and past treatments, which decrease stocking, improve diversity in age-class, decrease stand susceptibility to beetle caused mortality, and decrease beetle populations should decrease the effects of a mountain pine beetle outbreak. More stands stocked with moderate densities of mid-age to mature pine are likely to remain on the landscape, should the beetle outbreak continue.

Table 76 displays the mountain pine beetle risk rating of ponderosa pine stands within the cumulative effects area. Risk was calculated by the RMSTAND program for stands with tree data. Recently treated stands and stands planned for treatment were rated based on estimated post-treatment stand structure, average tree diameter, and stand density, following guidelines from the Rocky Mountain Forest and Range Experiment Station (Stevens, et al. 1980).

Table 76 Ponderosa Pine Stands: Mountain Pine Beetle Risk

| Risk Rating | Risk – Acres (% of PP Covertypes) |
|-------------|-----------------------------------|
| | Alt. 1 |
| No Rating | 434 (1%) |
| Low | 19,745 (45%) |
| Moderate | 15,156 (35%) |
| High | 8,346 (19%) |

Snags and Green Tree Retention

Alternative 1 would have no effect on existing snags and would leave all existing live trees as potential future snags. Mountain pine beetles, other insects, and disease caused mortality; weather events, and tree-to-tree competition would continue to create snags.

The Revised Forest Plan requires retention of sufficient large green trees to provide future large-diameter snags (standard 2302, guideline 2306). Alternatives 2, 3 and 4 would move hard snag densities toward Forest Plan standards. At least 3 live pine trees per acre over 20” in diameter (averaged across the watershed) should exist on north and east aspects, and 1.75 per acre on other slopes. These numbers would allow for large snag recruitment while maintaining minimum densities for large green trees (USDA Forest Service 2001). Other diameter classes are represented across the watershed to provide other sizes of snags and to provide trees that will grow to be over 20” in the future.

Using the Forest Vegetation Simulator, the number of live trees in each 2” diameter class from 10” to 20” DBH and 20”+ DBH in the ponderosa pine cover-type were estimated for each aspect and watershed for years 2003 and 2023 (USDA Forest Service 2001).

Table 77 Post Treatment Green Tree Retention on Pine Sites by Aspect and Watershed

| 7 th Order Watershed | Year and Alt. | Aspect | Live Pine Per Acre by 2" Diameter Class | | | | | |
|---------------------------------|---------------|--------|---|-----|--------|--------|--------|------|
| | | | 10-12" | 14" | 14-16" | 16-18" | 18-20" | >20" |
| 10120202060202 | 2003 | North | 9 | 15 | 23 | 15 | 4 | 2 |
| | | South | 25 | 25 | 24 | 13 | 12 | 3 |
| | Alt. 1: 2023 | North | 4 | 5 | 19 | 21 | 10 | 2 |
| | | South | 5 | 2 | 3 | 5 | 8 | 9 |
| | Alt. 2: 2023 | North | 4 | 5 | 19 | 21 | 10 | 2 |
| | | South | 5 | 2 | 3 | 5 | 8 | 9 |
| | Alt. 3: 2023 | North | 4 | 5 | 19 | 21 | 10 | 2 |
| | | South | 5 | 2 | 3 | 5 | 8 | 9 |
| | Alt. 4: 2023 | North | 4 | 5 | 19 | 21 | 9 | 2 |
| | | South | 5 | 2 | 3 | 5 | 8 | 9 |
| 10120202020105 | 2003 | North | 24 | 14 | 8 | 4 | 0 | 1 |
| | | South | 20 | 19 | 13 | 8 | 0 | 1 |
| | Alt. 1: 2023 | North | 25 | 14 | 11 | 5 | 0 | 2 |
| | | South | 20 | 15 | 14 | 12 | 0 | 3 |
| | Alt. 2: 2023 | North | 23 | 14 | 10 | 5 | 0 | 2 |
| | | South | 18 | 14 | 13 | 11 | 0 | 3 |
| | Alt. 3: 2023 | North | 23 | 13 | 11 | 7 | 0 | 2 |
| | | South | 17 | 12 | 12 | 11 | 0 | 3 |
| | Alt. 4: 2023 | North | 23 | 14 | 10 | 5 | 0 | 2 |
| | | South | 18 | 14 | 13 | 11 | 0 | 3 |
| 10120202060105 | 2003 | North | 21 | 17 | 8 | 3 | 2 | 1 |
| | | South | 25 | 30 | 14 | 5 | 2 | 1 |
| | Alt. 1: 2023 | North | 21 | 15 | 17 | 6 | 2 | 2 |
| | | South | 29 | 24 | 20 | 8 | 3 | 1 |
| | Alt. 2: 2023 | North | 15 | 13 | 17 | 6 | 2 | 2 |
| | | South | 28 | 25 | 20 | 8 | 3 | 1 |
| | Alt. 3: 2023 | North | 21 | 14 | 17 | 6 | 2 | 2 |
| | | South | 27 | 21 | 19 | 8 | 4 | 1 |
| | Alt. 4: 2023 | North | 15 | 13 | 17 | 6 | 2 | 2 |
| | | South | 28 | 23 | 20 | 8 | 3 | 1 |
| 10120202060106 | 2003 | North | 36 | 21 | 10 | 5 | 2 | 1 |
| | | South | 37 | 22 | 10 | 5 | 2 | 1 |
| | Alt. 1: 2023 | North | 29 | 21 | 13 | 12 | 3 | 2 |
| | | South | 34 | 22 | 14 | 9 | 4 | 2 |
| | Alt. 2: 2023 | North | 28 | 21 | | 12 | 3 | 2 |
| | | South | 31 | 22 | 14 | 9 | 4 | 2 |
| | Alt. 3: 2023 | North | 29 | 21 | 13 | 12 | 3 | 2 |
| | | South | 28 | 21 | 14 | 8 | 4 | 2 |
| | Alt. 4: 2023 | North | 28 | 21 | 13 | 12 | 3 | 2 |
| | | South | 31 | 22 | 14 | 9 | 4 | 2 |
| 10120202060104 | 2003 | North | 25 | 25 | 12 | 7 | 4 | 2 |

| 7 th Order | Year and Alt. | Aspect | Live Pine Per Acre by 2" Diameter Class | | | | | |
|-----------------------|-----------------|--------|---|--------|--------|--------|--------|------|
| | | | 10-12" | 12-14" | 14-16" | 16-18" | 18-20" | >20" |
| | | South | 27 | 22 | 12 | 6 | 3 | 3 |
| | | North | 27 | 26 | 15 | 10 | 7 | 3 |
| | Alt. 1: 2023 | South | 36 | 24 | 16 | 9 | 5 | 5 |
| | | North | 25 | 24 | 14 | 9 | 7 | 3 |
| | Alt. 2: 2023 | South | 32 | 22 | 14 | 8 | 4 | 5 |
| | | North | 26 | 25 | 25 | 10 | 7 | 3 |
| | Alt. 3: 2023 | South | 31 | 23 | 15 | 8 | 4 | 5 |
| | | North | 25 | 24 | 14 | 9 | 7 | 3 |
| 10120202060103 | 2003 | South | 32 | 22 | 14 | 8 | 4 | 5 |
| | | North | 25 | 18 | 8 | 4 | 3 | 2 |
| | Alt. 1: 2023 | South | 23 | 21 | 7 | 4 | 2 | 1 |
| | | North | 25 | 21 | 12 | 6 | 3 | 3 |
| | Alt. 2: 2023 | South | 31 | 22 | 13 | 5 | 3 | 2 |
| | | North | 24 | 21 | 12 | 6 | 3 | 3 |
| | Alt. 3: 2023 | South | 31 | 22 | 13 | 5 | 3 | 2 |
| | | North | 24 | 21 | 12 | 6 | 3 | 3 |
| 10120202070101 | 2003 | South | 22 | 20 | 12 | 5 | 3 | 2 |
| | | North | 24 | 21 | 12 | 6 | 3 | 3 |
| | Alt. 4: 2023 | South | 31 | 22 | 13 | 5 | 3 | 2 |
| | | North | 24 | 21 | 12 | 6 | 3 | 3 |
| | Alt. 1: 2023 | South | 35 | 24 | 17 | 12 | 8 | 5 |
| | | North | 42 | 31 | 17 | 8 | 4 | 2 |
| | Alt. 2: 2023 | South | 35 | 24 | 17 | 12 | 8 | 5 |
| | | North | 42 | 31 | 17 | 8 | 4 | 2 |
| 10120111020301 | 2003 | South | 35 | 24 | 17 | 12 | 8 | 5 |
| | | North | 42 | 31 | 17 | 8 | 4 | 2 |
| | Alt. 3: 2023 | South | 35 | 24 | 17 | 12 | 8 | 5 |
| | | North | 42 | 31 | 17 | 8 | 4 | 2 |
| | Alt. 4: 2023 | South | 35 | 24 | 17 | 12 | 8 | 5 |
| | | North | 42 | 31 | 17 | 8 | 4 | 2 |
| | Alt. 1: 2023 | South | 41 | 25 | 17 | 10 | 4 | 3 |
| | | North | 56 | 30 | 17 | 9 | 3 | 2 |
| 10120202060102 | 2003 | South | 41 | 25 | 17 | 10 | 4 | 3 |
| | | North | 56 | 30 | 17 | 9 | 3 | 2 |
| | | North | 19 | 26 | 13 | 8 | 3 | 3 |

| 7 th Order Watershed | Year and Alt. | Aspect | Live Pine Per Acre by 2" Diameter Class | | | | | |
|---------------------------------|---------------|--------|---|--------|--------|--------|--------|------|
| | | | 10-12" | 12-14" | 14-16" | 16-18" | 18-20" | >20" |
| | Alt. 1: 2023 | South | 33 | 25 | 14 | 7 | 4 | 2 |
| | Alt. 2: 2023 | North | 19 | 16 | 12 | 7 | 3 | 3 |
| | | South | 29 | 22 | 13 | 7 | 4 | 2 |
| | Alt. 3: 2023 | North | 19 | 16 | 13 | 8 | 3 | 3 |
| | | South | 27 | 21 | 14 | 7 | 4 | 2 |
| | Alt. 4: 2023 | North | 19 | 16 | 12 | 7 | 3 | 3 |
| | | South | 29 | 22 | 13 | 7 | 4 | 2 |
| | | | | | | | | |
| 10120111020103 | 2003 | North | 27 | 15 | 7 | 3 | 2 | 1 |
| | | South | 33 | 18 | 8 | 4 | 2 | 0 |
| | Alt. 1: 2023 | North | 22 | 14 | 10 | 4 | 2 | 2 |
| | | South | 24 | 18 | 11 | 6 | | 1 |
| | Alt. 2: 2023 | North | 21 | 13 | 10 | 4 | 2 | 2 |
| | | South | 22 | 17 | 11 | 6 | 3 | 1 |
| | Alt. 3: 2023 | North | 21 | 13 | 10 | 4 | 2 | 2 |
| | | | 19 | | 11 | 7 | 3 | 1 |
| | Alt. 4: 2023 | North | 21 | 13 | 10 | | 2 | 2 |
| | | South | 22 | 17 | 11 | 6 | 3 | 1 |
| | | | | | | | | |
| | | | | | | | | |
| 10120111020305 | 2003 | North | 33 | 18 | 9 | 4 | 2 | 1 |
| | | South | 40 | 18 | 10 | 5 | 3 | 2 |
| | Alt. 1: 2023 | North | 33 | 23 | 13 | 7 | 3 | 2 |
| | | South | 41 | 26 | 15 | 7 | 4 | 3 |
| | Alt. 2: 2023 | North | 31 | 22 | 13 | 6 | 3 | 2 |
| | | South | 41 | 26 | 15 | 7 | 4 | 3 |
| | Alt. 3: 2023 | North | 32 | 23 | 13 | 7 | 3 | 2 |
| | | South | 41 | 26 | 15 | 7 | 4 | 3 |
| | Alt. 4: 2023 | North | 31 | 22 | 13 | 6 | 3 | 2 |
| | | South | 41 | 26 | 15 | 7 | 4 | 3 |
| | | | | | | | | |
| | | | | | | | | |
| 10120111020102 | 2003 | North | 17 | 19 | 10 | 5 | 3 | 1 |
| | | South | 15 | 13 | 8 | 6 | 2 | 1 |
| | Alt. 1: 2023 | North | 15 | 18 | 12 | 8 | 5 | 3 |
| | | South | 15 | 12 | 11 | 7 | 5 | 3 |
| | Alt. 2: 2023 | North | 9 | 12 | 10 | 7 | 5 | 3 |
| | | South | 9 | 7 | 8 | 5 | 5 | 3 |
| | Alt. 3: 2023 | North | 14 | 18 | 12 | 8 | 5 | 3 |
| | | South | 10 | 10 | 10 | 6 | 5 | 3 |
| | Alt. 4: 2023 | North | 9 | 12 | 10 | 7 | 5 | 3 |
| | | | 9 | 7 | 8 | 6 | 5 | 3 |
| | | | | | | | | |
| | | | | | | | | |
| 10120111020104 | 2003 | North | 19 | 11 | 5 | 2 | 1 | 1 |
| | | South | 28 | 14 | 10 | 4 | 3 | 2 |
| | Alt. 1: 2023 | North | 33 | 15 | 7 | 4 | 1 | 1 |
| | | South | 37 | 18 | 12 | 4 | 4 | 3 |
| | | North | 33 | 15 | 7 | 4 | 1 | 1 |
| | | | | | | | | |

| 7 th Order Watershed | Year and Alt. | Aspect | Live Pine Per Acre by 2" Diameter Class | | | | | |
|---------------------------------|---------------|--------|---|--------|--------|--------|--------|------|
| | | | 10-12" | 12-14" | 14-16" | 16-18" | 18-20" | >20" |
| | Alt. 2: 2023 | South | 33 | 16 | 11 | 4 | 3 | 3 |
| | | North | 33 | 15 | 7 | 4 | 2 | 1 |
| | Alt. 3: 2023 | South | 34 | 17 | 12 | 4 | 3 | 3 |
| | | North | 33 | 15 | 7 | 4 | 1 | 1 |
| | Alt. 4: 2023 | South | 33 | 16 | 11 | 4 | 3 | 3 |
| | | North | 33 | 15 | 7 | 4 | 1 | 1 |
| 10120111020105 | 2003 | North | 22 | 13 | 6 | 3 | 2 | 1 |
| | | South | 21 | 10 | 4 | 2 | 2 | 2 |
| | 2023 | North | 31 | 18 | 9 | 4 | 2 | 2 |
| | | South | 29 | 14 | 7 | 2 | 2 | 2 |
| 10120111010103 | 2003 | North | 21 | 15 | 7 | 4 | 2 | |
| | | South | 20 | 15 | 9 | 4 | 2 | 2 |
| | 2023 | North | 27 | 17 | 11 | 5 | 3 | 3 |
| | | South | 24 | 16 | 12 | 6 | 3 | 3 |
| 10120111020201 | 2003 | North | 31 | 16 | 6 | 2 | 1 | 0 |
| | | South | | 16 | 5 | 3 | 1 | 0 |
| | 2023 | North | 30 | 22 | 10 | 4 | 1 | 1 |
| | | South | 32 | 20 | 11 | 4 | 2 | 0 |
| 10120111010204 | 2003 | North | 34 | 16 | 7 | 3 | 1 | 0 |
| | | South | 35 | 24 | 11 | 3 | | 0 |
| | 2023 | North | 53 | 20 | 10 | 5 | 2 | 1 |
| | | South | 37 | 24 | 18 | 6 | 3 | 1 |
| 10120111010301 | 2003 | North | 26 | 12 | 6 | 2 | 1 | 0 |
| | | South | 21 | 13 | 6 | 4 | 1 | 1 |
| | 2023 | North | 34 | 17 | 9 | 4 | 1 | 1 |
| | | South | 35 | 14 | 9 | 5 | 3 | 1 |

Alternatives 2, 3, and 4 would slightly decrease existing snag populations as some snags would need to be cut during harvest operations for safety reasons, however most snags would remain standing. Mountain pine beetles, other insects, disease caused mortality, weather events, and tree-to-tree competition would create snags. Due to thinning and reduced tree-to-tree competition, future mortality in the lower diameter classes should be less than Alternative 1, however growth of the remaining trees should provide green trees of larger diameter for future snag recruitment. Thinning and fuel treatments planned in these alternatives will retain the largest trees on site, and improve the growth of the remaining trees. Alternatives 2, 3, and 4 would slightly increase the number of large green trees in the future.

Wildlife Habitat

Affected Environment:

All acre summaries and habitat discussions are based on Forest Service land only, unless otherwise noted.

Existing Condition

The project area is characterized by vegetation cover type. Approximately 93% of the National Forest System land is in ponderosa pine, with 4.5% in hardwoods, 0.7% in spruce, and 1.5% in dry or riparian meadows, and 0.2% in nonvegetated areas. Dominance of ponderosa pine is a natural condition in the Black Hills, but pine is probably more dominant now than it was historically. Although other plant communities are in limited supply, they provide vital habitat components for many wildlife species.

Existing forest structure is generally dominated by stands of mature pine at various densities (Table 77). Pure stands of young trees are unusual. Many of the open stands have an understory of pine seedlings and saplings. Forest structural stage (SS) is described as follows:

- | | |
|---------------------------------------|--|
| SS 1: Grasses and forbs | SS 4A: Mature, open forest |
| SS 2: Seedlings and saplings | SS 4B: Mature, moderately dense forest |
| SS 3A: Young, open forest | SS 4C: Mature, dense forest |
| SS 3B: Young, moderately dense forest | SS 5: Late succession (“old growth”) |
| SS 3C: Young, dense forest | |

Refer to the forest vegetation resource description in this chapter for additional information on the existing forest structure.

Environmental Consequences

Table 79, Table 80 and Table 81 show post-treatment structural stage by cover type for each action alternative.

Table 78 Existing (Alternative 1) structural stage distribution by cover type

| Habitat | SS 1 | SS 2 | SS 3A | SS 3B | SS 3C | SS 4A | SS 4B | SS 4C | SS 5 | Total |
|--------------|---------------|---------------|---------------|---------------|-------------|--------------|--------------|---------------|-------------|----------------|
| Meadow | 635.3 | 0 | 0 | 0 | 0 | 21.4 | 0 | 0 | 0 | 656.7 |
| Aspen | 272.9 | 366.4 | 81.9 | 167.1 | 25.1 | 273.8 | 400.3 | 61.3 | 0 | 1648.8 |
| Birch | 15.4 | 39.2 | 80.9 | 54.4 | 95.6 | 0 | 25.1 | 0 | 0 | 310.6 |
| Bur oak | 0 | 11.2 | 0 | 0 | 0 | 0 | 0 | 34.4 | 0 | 45.6 |
| Pine | 474.1 | 1224.4 | 1975.1 | 2237.4 | 3573.0 | 10183.2 | 12237.3 | 9670.1 | 47.1 | 41621.7 |
| Spruce | 0 | 0 | 7.9 | 0 | 0 | 235.5 | 53.3 | 15.7 | 0 | 312.4 |
| Total | 1397.7 | 1641.2 | 2145.8 | 2458.9 | 3694 | 10714 | 12716 | 9781.5 | 47.1 | 44595.8 |

Table 79 Alternative 2 structural stage distributions by cover type

| | SS 1 | SS 2 | SS 3A | SS 3B | SS 3C | SS 4A | SS 4B | SS 4C | SS 5 | Total |
|---------|--------|--------|--------|--------|-------|---------|--------|--------|------|---------|
| Meadow | 635.3 | 0 | 0 | 0 | 0 | 21.4 | 0 | 0 | 0 | 656.7 |
| Aspen | 206.3 | 239.5 | 187.2 | 290.2 | 25.1 | 290.7 | 348.5 | 61.3 | 0 | 1648.8 |
| Birch | 15.4 | 39.2 | 82.6 | 52.7 | 95.6 | 18.5 | 6.6 | 0 | 0 | 310.6 |
| Bur oak | 0 | 11.2 | 0 | 0 | 0 | 0 | 0 | 34.4 | 0 | 45.6 |
| Pine | 414.1 | 1186.9 | 3247.4 | 2030.7 | 2523 | 13073.5 | 9675.9 | 9423.1 | 47.1 | 41621.7 |
| Spruce | 0 | 0 | 7.9 | 0 | 0 | 235.5 | 53.3 | 15.7 | 0 | 312.4 |
| Totals | 1271.1 | 1476.8 | 3525.1 | 2373.6 | 2644 | 13640 | 10084 | 9534.5 | 47.1 | 44595.8 |

Table 80 Alternative 3 structural stage distributions by cover type

| Habitat | SS 1 | SS 2 | SS 3A | SS 3B | SS 3C | SS 4A | SS 4B | SS 4C | SS 5 | Total |
|---------|--------|--------|--------|--------|--------|---------|--------|--------|------|---------|
| Meadow | 635.3 | 0 | 0 | 0 | 0 | 21.4 | 0 | 0 | 0 | 656.7 |
| Aspen | 206.3 | 239.5 | 187.2 | 290.2 | 25.1 | 290.7 | 348.5 | 61.3 | 0 | 1648.8 |
| Birch | 15.4 | 39.2 | 14 | 149.5 | 54.5 | 12.9 | 25.1 | 0 | 0 | 310.6 |
| Bur oak | 0 | 11.2 | 0 | 0 | 0 | 0 | 0 | 34.4 | 0 | 45.6 |
| Pine | 440.4 | 1214.1 | 2303.4 | 2958.5 | 2514.1 | 13251.9 | 9522.9 | 9369.6 | 47.1 | 41622.0 |
| Spruce | 0 | 0 | 7.9 | 0 | 0 | 235.5 | 53.3 | 15.7 | 0 | 312.4 |
| Totals | 1297.4 | 1504 | 2512.5 | 3398.2 | 2594 | 13812 | 9949.8 | 9481 | 47.1 | 44596.1 |

Table 81 Alternative 4 structural stage distributions by cover type

| Habitat | SS 1 | SS 2 | SS 3A | SS 3B | SS 3C | SS 4A | SS 4B | SS 4C | SS 5 | Total |
|---------|--------|--------|--------|--------|--------|---------|--------|--------|------|---------|
| Meadow | 635.3 | 0 | 0 | 0 | 0 | 21.4 | 0 | 0 | 0 | 656.7 |
| Aspen | 206.3 | 239.5 | 187.2 | 290.2 | 25.1 | 290.7 | 348.5 | 61.3 | 0 | 1648.8 |
| Birch | 15.4 | 39.2 | 82.6 | 52.7 | 95.6 | 18.5 | 6.6 | 0 | 0 | 310.6 |
| Bur oak | 0 | 11.2 | 0 | 0 | 0 | 0 | 0 | 34.4 | 0 | 45.6 |
| Pine | 414.1 | 1186.9 | 3488.9 | 1931.5 | 2380.5 | 13248.1 | 9501.5 | 9423.1 | 47.1 | 41621.7 |
| Spruce | 0 | 0 | 7.9 | 0 | 0 | 235.5 | 53.3 | 15.7 | 0 | 312.4 |
| Totals | 1271.1 | 1476.8 | 3766.6 | 2274.4 | 2501 | 13814 | 9909.9 | 9534.5 | 47.1 | 44595.8 |

Direct, Indirect, and Cumulative Effects

Effects on Meadows and Open Habitat

Structural stage 1 in the Grass cover type consists of grasses and forbs. Meadows are shown in Tables 77 through 80 as separate from forest structural stage 1, since the two designations are not synonymous. Meadows are natural openings and usually exist on soils formed under grass. Structural stage 1 under the various timber types is the first step in forest succession and occurs in forest openings such as clearcuts or patches of timber killed by mountain pine beetles. Meadows generally produce more forage than the grass/forb timber stage and often contain different plant composition.

Encroaching conifer removal was conducted under previous vegetation management projects within portions of the planning area. This project proposes to remove encroaching pine on 258 acres of meadow habitat under alternative 3, and prescribe burn

59 acres, with combined treatments on many acres. These treatments would maintain meadow habitat in the treated stands, restore plant vigor, and may slightly increase total meadow area.

Effects on Hardwood Habitat

Aspen and birch are important components of Black Hills habitat diversity. Deer and elk browse both species, while ruffed grouse, red-naped sapsuckers, and various songbirds use hardwood habitat for feeding and nesting. Young aspen stands are also very important deer fawning habitat (Kennedy 1992).

Conifers are encroaching many of the hardwood sites. Left untreated, these conifers will eventually overtake the hardwoods. Alternative 1 would result in an eventual decrease of hardwood acres.

The action alternatives include hardwood maintenance treatments consisting of pine removal, stand regeneration, or a combination of both. No alternative would remove all acres of any hardwood habitat structural stage. Prescribed fire will be applied to several hardwood stands to stimulate understory response of aspen. Some mortality of overstory trees will occur, creating snags and diversity with stands.

Effects on Open Mature Pine Habitat

Open mature pine stands (structural stage 4A) currently comprise 24% of the ponderosa pine cover type. While the average diameters are relatively small (9-13 inches) these stands still represent potential suitable habitat for several species, including pygmy nuthatch, Lewis' woodpecker, deer, elk, and several raptors.

All action alternatives would increase acreage of open mature ponderosa pine. Alternative 2 increases the portion of open mature stands to 31% of pine acres, and alternatives 3 and 4 increase open pine stands to 32%. As stands are thinned, diameter, tree height, and crown growth will accelerate, thereby moving these stands toward conditions more suitable for species requiring large-diameter open-grown ponderosa pine.

Underburning would be applied primarily in this habitat type, and would be low intensity to consume finer fuels and emulate historic fire behavior in open pine stands. The grass/forb understory component is expected to respond positively to burn treatments.

Effects on Moderate and High Density Pine Habitat and Late Succession

Dense mature pine stands (structural stages 4B and 4C) currently comprise 53% of the ponderosa pine type. Alternative 1 would retain all dense stands. However, many of these stands will be less dense after the current mountain pine beetle epidemic has run its

course. Alternative 2 would decrease dense stand acreage to 46% of ponderosa pine acreage, while alternatives 3 and 4 would decrease dense stands to 45%.

The project contains Management Area 3.7 (late succession forest landscapes). No alternative proposes any action in individual late succession stands identified in the Revised Forest Plan. Thinning treatments proposed under the action alternatives would accelerate development of large diameter trees on the landscape, while development of large trees under alternative 1 is expected to be considerably slower.

Effects on White Spruce Habitat

Approximately 312 acres of white spruce habitat are located in the project area. No treatment within these stands is proposed under any alternative.

Effects on Snag Habitat

Snags (dead standing trees) are an important habitat component for many species. Primary cavity nesters such as the black-backed woodpecker excavate their own cavities in dead trees that have rotting heartwood. Secondary cavity nesters such as the white-breasted nuthatch use natural cavities or abandoned woodpecker cavities.

Table 82 displays the existing average number of ponderosa pine snags by aspect, 10 inches in diameter or greater, in stands of ponderosa pine cover-type throughout the thirteen 7th order watersheds associated with the project area. Information regarding snag height is not available, and live trees with snag characteristics are not included. Several watersheds fail to meet Forest Plan standards for existing snags. The ongoing mountain pine beetle epidemic within Elk Bugs and Fuel is expected to create numerous additional snags across the landscape in 4B and 4C stands under all alternatives.

Table 82 Existing Pine Snags, 10" DBH and Larger (RMRIS Tree Data)

| Watershed (Watershed ID) | Aspect | Snags/Acre |
|-----------------------------|--------|------------|
| 10120202060202 | North | 1.0 |
| | South | 1.83 |
| 10120202020105 | North | |
| | South | 3.29 |
| 10120202060105 | North | 0.60 |
| | South | 1.18 |

| Watershed (Watershed ID) | Aspect | Snags/Acre |
|-----------------------------|--------|------------|
| 10120202060106 | North | 2.27 |
| | South | 4.29 |
| 10120202060104 | North | 2.74 |
| | South | 2.39 |
| 10120202060103 | North | 3.01 |
| | South | 2.97 |
| 10120202070101 | North | 6.04 |
| | South | 5.21 |
| 10120111020301 | North | 2.87 |
| | South | 2.52 |
| 10120202060102 | North | 4.95 |
| | South | 3.06 |
| 10120111020103 | North | 1.78 |
| | South | 2.32 |
| 10120111020305 | North | 2.42 |
| | South | 2.06 |
| 10120202060202 | North | 1.08 |
| | | 0.77 |
| 10120111020104 | North | 1.27 |
| | South | 1.66 |

Alternative 1

Alternative 1 would have no effect on existing snags and would leave all existing live trees in place as potential future snag habitat. It would have no immediate effect on dense stands, which are potential habitat for sensitive species such as northern three-toed woodpecker and black-backed woodpecker. Alternative 1 would result in short-term

habitat increases for these species, as retention and continued development or stagnation of dense stands would increase risk of insect infestation.

Snags in open-canopy stands are habitat for species such as Lewis' woodpecker and northern flicker. This habitat could diminish over time as open stands regenerate and become denser.

Snag recruitment rates are likely to be greatest under alternative 1 in the short-term since beetle-induced mortality is more likely in dense stands. Large trees, which are likely to be killed by mountain pine beetle during the current epidemic, will be fewer in the long-term under this alternative leading to fewer large snags in the long-term.

Alternatives 2, 3, and 4

Under the action alternatives, snags that pose a safety hazard during logging operations would be cut and retained on site, where they would add to the down woody component. All other existing snags would be left standing (see Appendix B, Mitigation).

All action alternatives would thin a portion of the project area's dense stands. Thinning would decrease short-term snag recruitment within treated stands since the residual trees would be less likely to succumb to insects, diseases, or natural mortality. Conversely, trees in thinned stands are expected to live longer and under better growing conditions, resulting in larger-diameter snags for the future. Thinning under this project is designed to retain the largest trees and remove smaller trees competing for resources, whereas mountain pine beetle will kill some large diameter trees.

Table 82 shows the residual mountain pine beetle risk level under individual alternatives for ponderosa pine stands. Using mountain pine beetle risk as an indicator of potential snag development from insect attack, the action alternatives would reduce the percentage of high-risk ponderosa pine stands from an existing 21% to a range of 18-19%. Stands at moderate risk would stay relatively constant under each alternative. When combining moderate and high risk categories, the action alternatives maintain between 58% and 59% of pine acreage at elevated pine beetle risk where some level of mortality, and natural snag creation, is reasonably certain to occur.

Table 83 Post-Treatment Mountain Pine Beetle Risk

| Risk Rating | Post-treatment Risk – Acres (% of PP Cover type) | | | |
|-------------|--|--------------|--------------|--------------|
| | Alt. 1 | Alt. 2 | Alt. 3 | Alt. 4 |
| Low | 16,464 (40%) | 17,274 (42%) | 16,692 (40%) | 17,303 (42%) |
| Moderate | 16,219 (40%) | 16,683 (40%) | 17,190 (41%) | 16,677 (40%) |
| High | 8,941 (21%) | 7,667 (18%) | 7,742 (19%) | 7,644 (18%) |

Effects on Green Tree Replacements

The Revised Forest Plan requires retention of sufficient large green trees to provide future large-diameter snags (standard 2302, guideline 2306). Using the Forest Vegetation Simulator, the number of live trees in each 2" diameter class from 10" to 20" DBH and 20"+ DBH in the ponderosa pine cover-type were estimated for each aspect and watershed for years 2003 and 2023. Alternative 2, 3 and 4 would move hard snag densities toward Forest Plan standards. At least 3 live pine trees per acre over 20" in diameter (averaged across the watershed) should exist on north and east aspects, and 1.75 per acre on other slopes. These numbers would allow for large snag recruitment while maintaining minimum densities for large green trees. Other diameter classes are represented across the watershed to provide other sizes of snags and to provide trees that will grow to be over 20" in the future (Project File, Section 2.2).

Effects on Down Woody Material

Availability of large down wood varies across the project area. Although large landing piles may be used for firewood, smaller piles and scattered logs remain to provide habitat for small mammals. Alternative 1 would have the greatest recruitment potential since all available trees could contribute to future recruitment. To ensure that proposed treatment areas are not lacking large, down woody material in the future, cull logs greater than 10" DBH would be left on site or returned to the site on all stands not requiring whole tree skidding. This mitigation would meet guideline 2307.

Effect on Fragmentation

Fragmentation consists of the breaking up of native vegetation structure and composition into smaller, more isolated patches. Overall impact of fragmentation on wildlife varies by species. Some species, such as deer and elk, are likely to benefit from increased fragmentation due to increased edge and smaller travel distance to a variety of stand conditions. Other species, such as some song birds, are likely to respond negatively to fragmentation because it increases the possibility of nest parasitism.

Average patch sizes of mature and old-growth conifer stands (structural stages 4A, 4B, 4C, and 5) were calculated by alternative and are shown in Table 84. Results indicate slight reductions in 4A and slight increases in 4B patches under the action alternatives. Patch size in structural stages 4C and 5 remain constant under all alternatives.

In addition to patch size, road densities on the landscape may also influence wildlife use of a given patch of habitat. Due to proposed decommissioning, open road densities decrease under all action alternatives (Table 85).

Fragmentation effects on species under the action alternatives in relation to alternative 1 are expected to be neutral to slightly positive due to minor changes in patch size and overall reductions in open road densities.

Table 84 Average Patch Size

| Alternative | Structural Stage Patch Size (Acres) | | | |
|-------------|-------------------------------------|------|------|------|
| | 4A | 4B | 4C | 5 |
| Alt. 1 | 35.4 | 30.1 | 37.1 | 23.5 |
| Alt. 2 | 34.1 | 30.4 | 37.1 | 23.5 |
| Alt. 3 | 33.9 | 30.8 | 37.1 | 23.5 |
| Alt. 4 | 34.0 | 30.4 | 37.1 | 23.5 |

Table 85 Open Road Density (miles per square mile)

| Alternative | Open Year-Long | Open Seasonally |
|-------------|----------------|-----------------|
| 1 | 1.5 | 1.5 |
| 2 | 1.1 | 1.2 |
| 3 | 1.1 | 1.2 |
| 4 | 1.1 | 1.3 |

THREATENED, ENDANGERED, AND SENSITIVE WILDLIFE SPECIES

Bald eagles (*Haliaeetus leucocephalus*) are the only federally listed (threatened) species occurring in the project area. They are frequent winter migrants on the Northern Hills Ranger District. However, no nesting is known to occur within the Black Hills National Forest. No other threatened, endangered, or proposed species is known to occur within the project areas nor does critical habitat exist. Habitat does not exist for black-footed ferret, black-tailed prairie dog, or mountain plover.

Species listed as Threatened, Endangered, and Proposed for Listing with potential to occur in Lawrence and Meade Counties, South Dakota are considered (Table 85). All sensitive species known to occur or potentially occurring on the Black Hills National Forest and nearby vicinity are considered (USDA 1994) and listed in Table 86. Species marked as “present” or “habitat present” are considered further for effects analysis.

Table 86 Habitat and Expected Occurrence of TEPS species within the project area.

| <i>Species</i> | <i>Status</i> | <i>Species Present</i> | <i>Habitat Present</i> | <i>Habitat Description</i> |
|----------------|---------------|------------------------|------------------------|---|
| Whooping Crane | E | | | Shallow wetlands and meadows; migratory in South Dakota (FWS WWW). |
| Bald Eagle | T | X | X | Usually found near unfrozen water or carrion in winter (Tallman et al. 2002). No nests or traditional roosts known in project area. |

| <i>Species</i> | <i>Status</i> | <i>Species Present</i> | <i>Habitat Present</i> | <i>Habitat Description</i> |
|------------------------------|----------------------|-------------------------------|-------------------------------|--|
| Least Tern | E | | | Shorelines, sandbars, and mudflats along rivers (FWS WWW). |
| Black-tailed Prairie Dog | C, S | | | Short-grass and mixed-grass prairies (FWS WWW). |
| Fringed-tailed Myotis | S | | X | Forages on insects in a variety of habitats including grasslands and forested areas. Roosts in a variety of structures including caves, mines, tunnels, and buildings (Schmidt 2003a). |
| Townsend's Big-eared Bat | S | | X | Forages on insects in a variety of habitats including forested and wet areas. Roosts in a variety of structures including caves, mines, and buildings (Schmidt 2003b). |
| Black-tailed Prairie Dog | S | | | Short-grass and mixed-grass prairies (FWS WWW). |
| American Marten | S | | X | Spruce forests with complex near-ground structure, extending into adjacent ponderosa pine stands. Dense pine for movement (Buskirk 2002). |
| Northern Goshawk | S | X | X | Forages in a variety of forested areas and small openings; Nests primarily in dense mature conifer forests (Erickson 1987). |
| Osprey | S | | | Lakes and large rivers with large populations of fish (Tallman et al. 2002). |
| Merlin | S | | | Open pine forests and prairie edges (Tallman et al. 2002). |
| Peregrine Falcon | S | | | Open areas and woodland edges (Tallman et al. 2002). |
| Upland Sandpiper | S | | | Grasslands. Uncommon and local in Black Hills (Tallman et al. 2002). |
| Western Yellow-billed Cuckoo | S | | | Low elevation riparian areas and woodlands characterized with cottonwood-willow or burr oak (Panjabi 2003, FWS www) |
| Western Burrowing Owl | S | | | Dry grasslands and pastures, usually associated with prairie dogs or ground squirrels (Tallman et al. 2002). |
| Flammulated Owl | S | | X | Open ponderosa pine forests (Hayward and Verner 1994). |
| Lewis' Woodpecker | S | | X | Open burned areas with large snags; oak and cottonwood forests (Anderson 2003, Panjabi 2003) |

| <i>Species</i> | <i>Status</i> | <i>Species Present</i> | <i>Habitat Present</i> | <i>Habitat Description</i> |
|--------------------------------|----------------------|-------------------------------|-------------------------------|--|
| Black-backed Woodpecker | S | | X | Burned areas with a high density of pre-burn snags; Dense and/or mature forests with a high snag density (Anderson 2003, Panjabi 2003). |
| Northern Three-toed Woodpecker | S | | X | Mature spruce forests, burned areas (Panjabi 2003). |
| Pygmy Nuthatch | S | | X | Mature pine and spruce forests (Panjabi 2003, Tallman et al. 2002) |
| Golden-crowned Kinglet | S | | X | Spruce forests, usually mature (Panjabi 2003). |
| Loggerhead Shrike | S | | | Open country with scattered, low deciduous thickets (Tallman et al. 2002). |
| Fox Sparrow | S | | | Shrubby woodlands, groves, and thickets (Tallman et al. 2002) |
| Tiger Salamander | S | | X | Non- or slow-flowing water bodies for reproduction; upland habitats with logs, stones, or other cover for adults (Smith in press) |
| Northern Leopard Frog | S | | X | Riparian and wetland areas for tadpoles, subadults, and breeding adults; upland habitats for foraging adults (Smith 2003). |
| Black Hills Redbelly Snake | S | | X | Moist habitats with well-developed ground litter (Smith and Stephens 2003). |
| Milk Snake | S | | X | Diverse habitats including meadows, woodlands, and pine forests. (Behler and King 1979). |
| Cockerell's Striate Disc | S | | X | Moist woodland sites with limestone substrate, often at the base of north-facing slopes or at the dry edge of riparian areas (Frest and Johannes 2002) |
| Cooper's Rocky Mountain Snail | S | | X | Lowland wooded or riparian areas on limestone soils (Frest and Johannes 2002) |
| Regal Fritillary Butterfly | S | | | Tallgrass prairie and extensive grasslands with violets. (Royer and Marrone 1992) |
| Tawny Crescent Butterfly | S | | X | Moist meadows and streams bottoms near forest openings (Marrone 2002). |
| | | | | |

*E=Endangered, T=Threatened, C=Candidate for federal listing, S=US Forest Service Region 2 Sensitive

Species specific Findings and Analysis of Effects

Bald Eagle (*Haliaeetus leucocephalus*)

Habitat summary: In the Black Hills, this species utilizes winter habitat where carrion is available (along highways and in big game winter range) and where there are open lakes and streams. It uses large diameter trees for hunting perches and roost trees.

Distribution/abundance: In the Black Hills, this species is a winter resident only (SDOU 1991). Bald Eagles have been documented in all counties in the Black Hills (District Files).

Threats: Threats are minimal. This species is a winter resident only in the Black Hills. There is no critical habitat designated in the Black Hills and no winter concentration areas are known. Use of chlorinated hydrocarbons is prohibited on the Black Hills National Forest (standard 3101 FP page II-43).

Direct/Indirect effects: Bald eagles are common winter migrants in the project area. They are not known to nest in the Black Hills either historically or in recent years. Quality habitat is lacking within the project area due to the absence of large fish-supporting streams. Small streams may support localized foraging, but not breeding populations of eagles. Eagles observed during the winter have been feeding on carrion including gut piles from harvested deer, road kills, and winterkills. Winter use of the project area is apparently random with no established winter concentration areas. Large trees suitable for roosting exist along some riparian areas, but are marginal habitat at best. Open stands with large trees occur within the analysis area away from water. Some winter roost trees could be removed, but Phase I standard 2306 will ensure large diameter trees are maintained across the landscape.

Cumulative effects: Carrion supply is expected to remain relatively unchanged. Additional large trees could be removed by private land logging, but effects would be negligible. With chlorinated hydrocarbons prohibited on the Forest, chemical contamination risk is low.

Determination: Risk levels are low. There would be no effect on bald eagles under any alternative.

Northern Goshawk (*Accipiter gentilis*)

Habitat summary: Nesting habitat is most often dense mature ponderosa pine (4C/5) in the Black Hills although denser 4B is also used in some cases (Erickson 1987). Fledgling habitat consists of pine in structural stages 3B, 3C, 4B, 4C, and 5 (Reynolds 1992). Foraging habitat is more dependent upon prey species and includes a variety of habitat types and structural stages.

Distribution/abundance: Goshawks were considered winter residents in South Dakota in the early 1900s with only suspected breeding occurring within the state (Over and Thoms 1920,1946). They are known from all Black Hills Counties and are considered a rare to uncommon resident in the Black Hills (SDOU 1991, Peterson 1990).

Threats: Loss of dense habitat for nesting and fledgling due to logging or wildfire. Also is susceptible to human disturbance during nesting period. Low reproductive rate makes recovery slow.

Direct/Indirect effects-

Nesting habitat: Several historic and active territories are known to occur within the project. All known and historic nest sites were surveyed for goshawk presence during 2002. Since comprehensive surveys of suitable habitat were not surveyed, the Interdisciplinary Team decided to removal all potential goshawk nesting habitat from harvest consideration. Stands were assessed for suitability using definitions provided by Erickson (1987), and consisted of conifer stands in habitat structural stages 4B and 4C with canopy closures equal to or greater than 60%, with inclusion of trees greater than 13 inches DBH. In total, 12,794 acres (29% of the project area) were classified as suitable nesting habitat and were deleted from timber management consideration. No treatment that alters habitat structural stage would occur in the historic, alternate, or suitable nest stands under any alternative (Mitigation #4, Appendix A). No timing restrictions are required since no treatment is proposed within ¼ mile of active nest stands.

Post fledgling habitat (PFA): A total of 8 PFAs were designated within or immediately adjacent to the project area. Some are associated with known or historic nest sites, while others were designated in areas devoid of known or historic nests to provide potential future nesting and post fledgling within empty territories. Since no treatments expected to alter stand habitat structure are proposed in the PFAs, all alternatives will maintain the current balance of structural stages.

Forage habitat: Existing foraging habitat is maintained under alternative 1 and is essentially maintained under the action alternatives since alternatives were designed to

meet goshawk nesting requirements and habitat effectiveness standards for big game. Application of underburning and prescribed fire is expected to enhance forage habitat for goshawks.

Cumulative effects: Nest stands and their associated PFAs are being tracked in the District database for future planning efforts. There would be similar future trends for nesting, PFA, and foraging habitat under all alternatives since treatments do not alter existing nesting habitat or designated PFAs. Vegetation management activities that are ongoing or reasonably certain to occur were considered as already implemented on the landscape when PFAs were designated for this project.

Private land adjacent to PFAs could be logged or developed, although no plans are known at this time. While this could impact habitat in the immediate area, private land was not included in PFA designation or acre calculations. The greatest potential threat from private land logging or development would be disturbance during nesting season. The Forest Service has no jurisdiction over private land or authority to impose timing restrictions on private land activities.

Determination: Alternative 1 would have no impact. Alternatives 2, 3, and 4 may adversely impact individuals through disturbance or changes in forage habitat, but are not likely to result in a loss of viability in the planning area, nor cause a trend to federal listing. This determination is made based on designation of the PFAs and retention of suitable nest stands. Actual use of these areas may vary.

Black-backed woodpecker (*Picoides arcticus*)

Habitat summary: Suitable habitat includes bug-killed or fire-killed conifer, and structural stages 4C, and 5 in undisturbed spruce and pine stands (Mohren 2002).

Distribution/abundance: In the Black Hills, this species is considered a rare permanent resident in higher elevations (SDOU 1991). This species' preference for burned forests in a time of fire suppression, its eruptive populations and lack of population information has identified it as a species of concern (Finch 1992).

Threats: This species requires dense habitat with large diameter snags. Salvage logging is detrimental to the species.

Direct/Indirect effects: Alternative 1 would maintain the current 23% of ponderosa pine stands in potential suitable habitat. The action alternatives would also retain potential habitat within 23% of pine acres. Acres remaining in 4C are at high risk of mountain

pine beetle attack, and represent potential for some level of mortality and snag creation in the near future.

In addition to dense stands undergoing mountain pine beetle infestation, the Grizzly Gulch Fire, which burned in 2002, created about 2,729 acres of suitable habitat (moderate and high burn severity) on Forest Service acres within the project area. Treatments under this project do not propose to enter areas affected by the Grizzly Gulch Fire. Removal of snags that pose safety hazards to harvest operations is a possibility and could remove potential nest trees. In addition, sanitation harvest on 396 acres in alternatives 2 and 4 could remove the same bug-infested trees utilized by foraging woodpeckers.

Application of underburning in moderately dense stands is not expected to negatively impact this species since structural stages will not change.

Cumulative effects: With an emphasis in the Black Hills toward thinning stands to reduce insect, disease, and wildfire risk, the trend of habitat availability for this species is likely to be downward. However, recent wildfires across the Forest have created a substantial amount of suitable habitat. Recently modified Forest Plan standards that require habitat retention for big game, marten, and goshawk, as well as minimum retention levels of snags and green tree replacements are expected to favor habitat retention for black-backs in the long-term. Approximately 2,729 acres of suitable habitat created by the Grizzly Gulch Fire are not proposed for salvage entry on Forest Service acres by any project at this time. Salvage activities are however, underway on private and BLM lands.

Several vegetation management projects are currently occurring or are reasonably certain to occur within the project area, including Boulder, Redhill, Piedmont, Kirk, Cavern, and Dano timber sales, and sales associated with Public Law 107-206. Existing potential suitable habitat for black-backs totals 8,108 acres or 19% of pine acreage, when taking into account these projects. Cumulatively, alternatives 2, 3, and 4 would retain potential suitable habitat to 19% of pine acreage. Management actions taken cumulatively may impact individuals, but are not expected to cause a trend to federal listing or a loss of species viability range-wide.

Determination: There would be no impact under alternative 1. The habitat with highest potential for use and occupancy (structural stages 4C and 5) would remain essentially unchanged under the action alternatives. Some removal of less suitable habitat (structural stage 4B) would occur under all action alternatives. Proposed activities may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend to federal listing.

Northern three-toed woodpecker (*Picoides tridactylus*)

Habitat summary: Suitable habitat includes bug killed stands and large burns in conifer associations, and closed canopy mature and old growth spruce associated with aspen in undisturbed habitat (Mohren 2002).

Distribution: The species is a rare resident in the higher elevations of the Black Hills and has been documented in a few locations in Lawrence, Pennington and Custer Counties. It is listed as absent in northeastern Wyoming (WGF1992).

Threats: This species is vulnerable to loss of dense habitat with large snags, salvage timber harvest and fire suppression.

Direct/Indirect effects: In undisturbed habitat, this species is generally associated with older spruce, which is represented on only 305 acres within the Elk Bugs and Fuel project area. No stands of spruce are proposed for treatment under this project.

Population irruptions have been noted in areas with large-scale disturbance such as wildfires and insect outbreaks (Hutto 1995, Yeager 1955, Murphy and Lehnhausen 1998). In addition to habitat created by the Grizzly Gulch Fire, which burned over 3,000 acres within the project area, ponderosa pine mortality is occurring due to the mountain pine beetle epidemic, which may attract use by three-toed woodpeckers.

Alternative 1 would maintain the current 23% of ponderosa pine stands in potential suitable habitat. The action alternatives would also retain potential habitat within 23% of pine acres. Acres remaining in 4C are at high risk of mountain pine beetle attack, and represent potential for some level of mortality and snag creation in the near future.

Application of underburning in dense stands is not expected to impact this species since structural stages will not change. Consumption of large logs used as potential foraging is expected to be minimal.

Cumulative effects: Cumulative effects are similar to those discussed for black-backed woodpecker.

Determination: There would be no impact under alternative 1. Reductions in potential for insect-induced tree mortality under all action alternatives may negatively impact this species; however, retention of existing spruce stands, as well as structural stages 4C and 5 in ponderosa pine stands minimizes the potential for impacts to local populations.

Alternatives 2, 3, and 4 may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend to federal listing.

Lewis' Woodpecker (*Melanerpes lewis*)

Habitat summary: Habitat occurs within burns, also in large, open pine (structural stages 4A, 5), and deciduous riparian with snags >19”.

Distribution/abundance: In the Black Hills, this species is described as quite rare. Panjabi (2003) reports only three sightings, all located in the southwest portion of the Forest, and recommends that burned areas be more intensively monitored for population status of this species.

Threats: This species is vulnerable to loss of large snags and large diameter trees through timber harvest.

Direct/Indirect effects: Potential habitat occurs within structural stage 4A; however, these stands are marginally suitable due to small tree and snag size. Burned areas, which are described as preferred habitat for this species, occur in the northwestern portion of the project area (Grizzly Gulch Fire). Alternative 1 would maintain the current 28% of the ponderosa pine cover type that may be marginally suitable due to smaller tree diameters, and maintain suitable habitat within the Grizzly Gulch burn.

Alternatives 2, 3, and 4 would increase 4A stands to 31%, 32%, and 32% of ponderosa pine, respectively. Removal of snags that pose safety hazards to harvest operations is a possibility and could remove potential nest trees. However, snag removal is expected to be rare. Trees larger than 20 inches dbh could be harvested; however, since treatments prescribe thinning from below where smaller diameter trees are targeted for removal, the potential for harvest for trees larger than 20 inches is low. No overstory removal treatments are proposed under any alternative.

Phase I snag requirements would ensure that the large diameter trees are left/promoted and that large snags are available long-term in all treatment units. Standard silvicultural thinning to 60-80 basal area on the commercial thins will also open the canopy, thereby accelerating development of large-diameter trees and snags. Prescribed burning and underburning will not affect habitat for Lewis' woodpecker, and may enhance stands by removing competing understory trees.

Cumulative effects: The Forest-wide trend toward increased commercial thinning and seed tree retention cuts presents long-term habitat benefits at the landscape level. Due to

current lack of large trees on the landscape, treatments that remove large trees, such as overstory removal, are likely to create habitat gaps. Snag standard 2306 will ensure maintenance/creation of large diameter trees and snags over time and will eventually benefit the species. As suitable large diameter trees/snags develop over time in the open habitat, downward population trends should be reversed.

Several vegetation management projects are currently occurring or are reasonably certain to occur within the project area, including Boulder, Redhill, Piedmont, Kirk, Cavern, and Dano timber sales, and sales associated with Public Law 107-206. Existing potential suitable habitat for Lewis' woodpecker totals 11,635 acres or 28% of pine acreage, when taking into account these projects. Cumulatively, alternatives 2, 3, and 4 would all increase potential suitable habitat to 35%. Management actions taken cumulatively may impact individuals, but are also expected to benefit this species. Cumulatively, no trend toward federal listing or loss of species viability is expected.

Determination: Alternative 1 would have no impact. Since individual trees used by this species may be harvested, but occur in marginally suitable habitat, and since habitat with the highest suitability will remain unaltered, the action alternatives may adversely impact individuals, but are not are likely to result in a loss of viability in the Planning Area, nor cause a trend to federal listing.

Pygmy Nuthatch (*Sitta pygmaea*)

Habitat summary: Open pine structural stage 4A, 5; needs snags > 17" dbh.

Distribution/abundance: Sightings of this species within the Black Hills have been very rare. Panjabi (2003) found only 2 individuals via surveys within the Black Hills.

Threats: This species is vulnerable to loss of large snags and large diameter trees through timber harvest.

Direct/Indirect effects: Diameters of existing live trees in structural stage 4 stands within the project area are small, averaging 9-13 inches, with correspondingly small snag sizes. Therefore, habitat suitability within the project area is currently marginal. Larger diameter stands, more likely to be suitable for this species, are available on only 47 acres within structural stage 5.

Alternative 1 would maintain existing habitat. Under the action alternatives, thinning treatments will occur in structural stage 4A and 4B stands which average only 9-13 inches dbh. All action alternatives have the potential to remove existing snags that pose a safety problem in treatment units, and therefore could reduce suitable nest trees.

However snag removal is expected to be rare. Trees larger than 20 inches dbh could be harvested, but treatments prescribe thinning from below where smaller diameter trees are targeted for removal. Therefore, the potential for harvest for trees larger than 20 inches is low.

Cumulative effects: Similar to those described for Lewis' woodpecker.

Determination: Alternative 1 would have no impact. The action alternatives have a low probability of removing suitable nest trees in habitat estimated to be marginally suitable. Since treatments are proposed in marginal habitat and have a low probability of removing suitable nest trees, and no treatments in suitable habitat (structural stage 5) is proposed, the action alternatives may adversely impact individuals, but not are likely to result in a loss of viability in the Planning Area, nor cause a trend to federal listing.

Flammulated Owl (*Otus flammeolus*)

Habitat summary: Larger diameter (18-29 inches, McCallum 1994) mature and old growth open-grown ponderosa pine for nesting and foraging; dense pine or mixed conifer stands for roosting.

Distribution/abundance: This species was unknown in the Black Hills until several recent sightings. Surveys for this species have not occurred in the Black Hills. Current distribution and density is unknown.

Threats: Removal of large-diameter snags; overstory removal of large-diameter ponderosa pine.

Direct/Indirect effects: Alternative 1 would maintain existing conditions, which consist of 10,183 acres (25% of pine acreage) of mostly small-diameter (9-13 inches) open pine stands that may serve as suitable nesting/foraging habitat, but is most likely marginal due to the small size. An abundance of roosting habitat (21,907 acres in habitat structural stages 4B and 4C) would be maintained across the landscape.

The action alternatives would create and maintain more acres in pine structural stage 4A, totaling 31% of pine acreage. While existing diameters may be small, and therefore marginally suitable, lower basal area will allow these stands to accelerate to a large-diameter condition in the future. All action alternatives would provide more acres of future suitable nesting habitat than alternative 1. The action alternatives would maintain between 45% and 46% of pine acreage in potential roosting habitat. Underburning may impact individuals due to smoke, but the effect will be minor due to the short duration of smoke presence in the stand.

All action alternatives have the potential to remove existing snags that pose a safety problem in treatment units, and therefore could reduce suitable nesting habitat. However, snag removal is expected to be rare, and existing habitat in treatment units is marginally suitable for nesting. Trees larger than 20 inches dbh could be harvested; however, since treatments prescribe thinning from below where smaller diameter trees are targeted for removal, the potential for harvest for trees larger than 20 inches is low.

Cumulative effects: Current planning efforts for vegetation management projects on the Northern Hills Ranger District emphasize thinning of dense stands. Thinning treatments applied across the landscape are expected to increase future suitable habitat for this species by accelerating tree growth and reducing the potential loss of overstory trees to insects, disease, and wildfire.

Several vegetation management projects are currently occurring or are reasonably certain to occur within the project area. Existing potential nesting and foraging habitat for Flammulated owls totals 11,635 acres or 28% of pine acreage, when taking into account these projects. Cumulatively, alternatives 2, 3, and 4 would all increase potential suitable nesting and foraging habitat to 35%. However, stand diameters in the short-term remain small and constitute habitat that is marginally suitable. Cumulatively, a trend toward federal listing or a loss of species viability range-wide is not expected.

Determination: Alternative 1 would have no impact. Since there is a low potential for removal of trees used by this species, and treatments are proposed in marginal habitat with smaller tree diameters, the action alternatives may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend to federal listing. The action alternatives are likely to benefit this species in the long-term by increasing availability of large-diameter trees.

Golden-Crowned Kinglet (*Regulus satrapa*)

Habitat Summary: mature and late-succession spruce (Panjabi 2003).

Distribution/abundance: This species is an uncommon resident in upper elevations of the Black Hills (SDOU 1991). Panjabi (2002) estimated 13-26 birds per square kilometer in spruce stands within the Black Hills National Forest.

Direct/Indirect Effects: No treatments in spruce stands are proposed under any alternative. No impacts to suitable habitat are expected.

Cumulative effects: Forest Plan standard 3215, which prevents alteration of mature spruce habitat, prevents losses of suitable habitat at the landscape level.

Determination: Due to a lack of impacts to suitable habitat, all alternatives are expected to have no impact on golden-crowned kinglets.

Marten (*Martes americana*)

Habitat summary: spruce, predominantly structural stages 3B, 3C, 4B, 4C and 5 and pine 3B, 3C, 4B, 4C, and 5 with greater than 30% basal area in spruce and greater than 40% crown closure.

Distribution/abundance: Pine marten historically occurred within the Black Hills, but are thought to have been trapped out by 1930. Forty-two marten were re-introduced on the Spearfish District near Cheyenne Crossing between 1980 and 1981 (Fredrickson, 1989). Marten are frequently sighted near the re-introduction sites and by 1988 had spread to as far away as Cement Ridge, Galena, Bridal Veil Falls, and Higgins Gulch. Known and predicted pine marten distribution patterns show similar trends indicating that the distribution of pine marten is contained within a region that extends from the northern Black Hills, southeast to the Norbeck Wildlife Preserve and Black Elk Wilderness Area in the central Black Hills. The population has been increasing since 1980 with current population estimated at 580 individuals (SD GF&P unpublished data).

Threats: Trapping is regulated; susceptible to habitat loss and degradation from forest management activities.

Direct/Indirect effects: No treatment would occur in marten habitat (spruce) under any alternative. Alternative 1 would maintain existing dense pine stands that serve as potential movement corridors. The action alternatives treat dense pine, and therefore, may influence marten movement across the landscape. The creation of fuel breaks across the landscape has the potential to influence and possibly limit marten movements within the project area. However, Mitigation #4 (Appendix A) is expected to retain suitable connective habitat for marten.

Cumulative effects: Vegetation management activities that are ongoing or reasonably certain to occur within the project area were assessed for impacts to spruce habitat. The amount of spruce acres, as well as the structural stages of these stands, would not change cumulatively. No negative cumulative impact to this species is expected to occur as a result of management actions.

Determination: There would be no impact on marten under alternative 1. Since marten movement on the landscape could be influenced, the action alternatives may adversely impact individuals, but are not likely to result in a loss of viability in the planning area, nor cause a trend to federal listing.

Townsend's Big-eared Bat (*Corynorhinus townsendii*)

Habitat summary: suitable caves, mineshafts.

Distribution/abundance: Known from Fall River, Custer, Pennington, Lawrence, Meade counties in SD and Crook County, WY. Eastern sub-species listed as endangered. Suspected downward trend across species range including the Black Hills (Western Bat Working Group). Uncommon relative to other bat species based on hibernacula counts conducted in the Black Hills. Known population Forest wide is estimated at 1500 –1800 (Jewel Cave Counts, unpublished).

Threats: Winter habitat is declining due to mine closure/collapse and recreational use of caves. Hibernacula and maternity roosts highly sensitive to disturbance.

Direct/Indirect effects: None of the alternatives propose harvest adjacent to known caves on federal land. Preventing mine collapse and limiting recreational use are outside the scope of this document. No conflicts are known at this point.

Cumulative effects: No negative cumulative effects are expected for this species.

Determination: There will be no impact on Townsend's big-eared bat populations under any alternative.

Fringed-tailed myotis (*Myotis thysanodes*)

Habitat summary: This species feeds mainly on small moths high in the forest canopy and on or near the ground near thick or thorny vegetation. They may occasionally glean insects from leaves (Barbour and Davis, 1969). Suitable caves and mine shafts are used as roosting, maternity sites and hibernating. Cryan (2001) found fringe-tailed bats in the Black Hills roosting in rock crevices as well as in cavities of ponderosa pine snags (rather than under exfoliating bark).

Distribution/abundance: Known locations are found in Lawrence, Meade, Pennington and Custer Counties of South Dakota and possibly Crook and Western Counties in

Wyoming (Schmidt 2003a). Factors that affect this species are human disturbance of roosting and hibernation sites, low reproductive rate and habitat loss. Disturbance by humans, especially in hibernacula and maternity roosts, can be a threat to survival of these animals (Barbour and Davis 1969).

Threats: Disturbance to hibernacula and maternity roosts, loss of habitat due to mine closure/collapse.

Direct/Indirect effects: None of the alternatives propose harvest adjacent to known caves on federal land. Preventing mine collapse and limiting recreational use are outside the scope of this document. Proposed treatments may remove snags that pose a hazard to harvest operations, but snag removal is expected to be rare.

Cumulative effects: No negative cumulative effects are expected for this species.

Determination: There is a possibility that snags posing an operational hazard may be removed. However, due to the estimated rarity of this occurrence, in addition to the species use of habitats other than snags, the action alternatives may impact individuals, but are not to result in a loss of viability in the Planning Area, nor cause a trend to federal listing. Alternative 1 will have no impact on populations or habitat.

Cooper's Rocky Mountain Snail (*Oreohelix strigosa cooperi*)

Habitat summary: Habitat includes lowland wooded areas and talus slopes. Moist woodlands adjacent to riparian areas.

Distribution/abundance: This species is common in Spearfish Canyon drainages and occurs elsewhere in scattered populations (Frest and Johannes 2002). A total of 4 sites within the project area were surveyed for this species (Frest and Johannes 1993, 2002). No specimens were found.

Threats: Drying of site through extensive logging, overgrazing of riparian areas especially around seeps and springs.

Direct/Indirect effects: This species has potential to occur in areas adjacent to treatment sites. However, the potential is low since the highest potential sites within the project

area were surveyed by Frest and Johannes with no positive results. Water sources that may influence species occurrence are buffered from treatment (see Mitigations).

Cumulative effects: Frest and Johannes (2002) identify grazing as an activity that has potentially limited distribution of this and other snail species of concern. Grazing distribution and intensity would remain constant under all alternatives. No cumulative impacts to this species are expected since water sources that may influence habitat suitable for this species are required to be buffered from treatments.

Determination: Alternative 1 will have no impact on populations or habitat. While the species may occur within or adjacent to treatment units associated with the action alternatives, the potential for occurrence is low. In addition, potential for impacts to hydrology that influences suitable habitat are low due to prescribed buffers. Therefore, the action alternatives may impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend to federal listing.

Cockerell's Striate Disc Snail (*Discus shimeki cockerellii*)

Habitat summary: Moist woodlands north-facing slope bases adjacent to spruce with a deciduous association on north aspects with limestone derived soils (Frest and Johannes 2002).

Distribution/abundance: In the Black Hills, this species is locally abundant in a limited number of colonies. A total of 4 sites were surveyed for this species within the project area (Frest and Johannes 1993, 2002). No specimens were found.

Threats: Drying of site through extensive logging, overgrazing of riparian areas.

Direct/Indirect effects: No occurrence of this species within the project area is known. Potential habitat associated with spruce would not be affected under any alternative.

Cumulative effects: Frest and Johannes (2002) identify grazing as an activity that has potentially limited distribution of this and other snail species of concern. Grazing distribution and intensity would remain constant under all alternatives. No cumulative impacts to this species are expected since water sources that may influence habitat suitable for this species are required to be buffered from treatments. Forest Plan standard 3215 ensures existing spruce stands will be retained Forest-wide. No negative cumulative impacts are expected.

Determination: Risk levels are low. All alternatives would have no impact on snail populations due to a lack of treatment in potential habitat.

Northern Leopard Frog (*Rana pretiosa*)

Habitat summary: cattail marshes, beaver ponds, small stock ponds, permanent water sources.

Distribution/abundance: Known from all Black Hills counties. Listed as in suitable habitat (Smith 2003). Creation of small stock ponds may have increased the availability of breeding sites and habitat for this species of frogs.

Threats: Vulnerable to habitat loss/alteration from overgrazing, predation, and reduced water quality/quantity.

Direct/Indirect effects: Suitable habitat occurs sparsely within on much of the project area. Breeding habitat is limited to riparian areas, old beaver ponds, dugouts, and springs. All alternatives would maintain the current breeding habitat. Grazing impacts, both positive and negative, would be dealt with in Allotment Management Plans and associated environmental analyses. Prescribed burning and underburning would not occur in suitable breeding habitat.

Cumulative effects: Backlund (USDA 2000) identifies uncontrolled grazing as having detrimental impacts on populations of leopard frogs. Grazing distribution and intensity would remain constant under all alternatives. No cumulative impacts to this species are expected since water sources that may influence habitat suitable for this species are required to be buffered from treatments

Determination: Alternative 1 would have no impact. Alternatives 2, 3, and 4 are unlikely to impact suitable habitat or populations. Therefore, proposed alternatives may impact individuals, but are not likely to result in loss of species viability, nor cause trend toward federal listing.

Tiger Salamander (*Ambystoma tigrinum*)

Habitat summary: temporary pools, damp meadows, under debris.

Distribution/abundance: No local population trend data is available, but habitat appears stable.

Threats: Loss of riparian and other breeding habitat and reduced water quality.

Direct/Indirect effects: Suitable habitat occurs on much of the project area. However, breeding habitat is limited to riparian areas, old beaver ponds, dugouts, and springs. All alternatives would maintain the current habitat.

Cumulative effects: Water quality can be affected by livestock and mining. Corn (USDA 2000) states that livestock degradation of wet areas during the spring can have detrimental effects to salamanders due to egg-trampling and siltation. Grazing distribution and intensity would remain constant under all alternatives. No cumulative impacts to this species are expected since water sources that may influence habitat suitable for this species are required to be buffered from treatments.

Determination: Risk levels are low. Alternative 1 would have no impact. Alternatives 2, 3, and 4 are unlikely to negatively impact habitat or populations. Therefore, the action alternatives could impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor a trend toward federal listing.

Black Hills Red-bellied Snake (*Storeria occipitomeoculata pahasapae*)

Habitat summary: Beneath downed logs, slash, debris, and rocks in forests between 4,700 and 6,400 feet elevation (Smith and Stephens 2003).

Distribution/abundance: Range of this subspecies is limited to the Black Hills of western South Dakota and northeastern Wyoming. This species is endemic, uncommon (survey data limited) and has been documented in all counties. There is no local population trend data available. Not much is known on distribution, abundance and dispersal due to secretive behaviors.

Threats: Minimal. May be susceptible to predation where ground cover is lacking.

Direct/Indirect effects: The entire planning area is considered suitable habitat for the red-bellied snake. Displacement of individuals may occur under the action alternatives as downed logs are potentially moved during skidding operations; however, downed logs would not be removed from the site. Forest Plan standard 2308 provides direction for maintaining down woody debris in logging units. No barriers adjacent to wetlands would be created under any action alternative.

Prescribed fire would be applied in suitable habitat. Individuals may be impacted due to reductions in forest floor litter and structure, but overall distribution and abundance of this species would not be compromised. Prescribed burning may cause individual snake mortalities, but no impacts to populations are expected.

Cumulative Effects: No negative cumulative effects are expected for this species.

Determination: Risk levels are low. Alternative 1 would have no impact. Alternatives 2, 3, and 4 are unlikely to impact habitat or populations. Therefore, the action alternatives may impact individuals, but are not likely to result in a loss of viability within the Planning Area, nor cause a trend toward federal listing.

Pale Milk Snake (*Lampropeltis triaulum*)

Habitat summary: Occupies very diverse habitat types from semiarid to damp coastal bottomlands to Rocky Mountain and tropical hardwood forests, pine forests, open deciduous woodlands, rocky hillsides, sand dunes, meadows, prairies, high plains, farmland, and suburban areas to 8000 feet elevation. This species is secretive and nocturnal, generally found under rotting logs, stumps, or decaying trash (Behler and King 1979).

Distribution/abundance: In the Black Hills, this species is rare (survey data limited) but have been documented in all counties at lower elevations. Not much is known on distribution, abundance and dispersal due to secretive and nocturnal behaviors.

Threats: Minimal. May be susceptible to predation where ground cover is lacking.

Direct/Indirect Effects: The entire planning area is considered suitable habitat for the milk snake. Displacement of individuals may occur under the action alternatives as downed logs are potentially moved during skidding operations; however, downed logs would not be removed from the site. Forest Plan standard 2308 provides direction for

maintaining down woody debris in logging units. Prescribed burning may cause individual snake mortality, but no impacts to populations are expected.

Cumulative effects: No negative cumulative effects for this species are expected.

Determination: Risk levels are low. Alternative 1 would have no impact. Treatments have a low potential for impacting suitable habitat or populations. Therefore, the action alternatives may impact individuals, but not likely to cause a loss of viability or trend toward federal listing due to displacement rather than loss of habitat.

Tawny Crescent Butterfly (*Phyciodes batesi*)

Habitat summary: This species is restricted to moist forest borders, particularly riparian areas, and moist valley bottoms in the transition between deciduous and coniferous forests (Royer and Marrone 1992). Specimens have been collected on the District.

Distribution/abundance: In the Black Hills, this species is known in Lawrence, Pennington, Meade and Custer counties in South Dakota and Crook and Weston counties in Wyoming with being rare to uncommon at known sites. There is no local population trend data available but this species has been disappearing from its range in the eastern United States.

Threats: habitat loss (e.g. riparian areas), pesticide/herbicide application, and lost of host species (Royer and Marrone 1992).

Direct effects: Riparian areas within the project area are associated with meadows or aspen. No alteration of existing hydrological function or riparian character is expected under any alternative.

Cumulative effects: No pesticides are currently being used on the Northern Hills Ranger District. Herbicides are being applied locally, targeting patches of noxious weeds, but riparian areas are generally avoided. No negative cumulative impacts for this species are expected.

Determination: Risk levels are low under all alternatives. Since treatments are not expected to impact populations or suitable habitat, no impacts are expected.

Mitigation

Objectives, standards and guidelines have been identified in the Forest Plan BA/BE that provides mitigation for all Federally listed and Region 2 Sensitive Species found in the Black Hills. This project will follow the objectives, standards, and guidelines that are applicable to species and habitats found within the Elk Bugs and Fuel analysis area. Mitigation measures are found in the Elk Bugs and Fuel wildlife specialist report, the 1996 Revision-Land and Resource Management Plan (BHNF) and 2001 Phase 1 Amendment Decision Notice (BHNF). Mitigations are incorporated into this document by reference and form the basis for the determinations.

Determination of Effects

The determination of effects on Federally listed species and Region 2 Sensitive Species in this document, were made as the result of the information gathered in the pre-field review, field reconnaissance and effects analysis. The basis for these determinations was potential habitat, distribution, effects from forest activities and proposed mitigation. The determination language is set forth in Forest Service Manual 2670 and by the U.S. Fish and Wildlife Service.

With implementation of the mitigation measures, a determination of “No effect” would apply to all Federally listed species that may be found in Elk Bugs and Fuel (bald eagles). With implementation of the mitigation measures, the Forest Plan BA/BE determinations of “No impact”, “Beneficial impact”, or “May adversely impact individuals, but not likely to result in a loss of viability in the planning area, nor cause a trend to federal listing” would apply to Region 2 sensitive species found in the project area. Any non-compliance with mitigations identified in Appendix A could alter the determination and lead toward trends to Federal listing. Individual determinations are summarized in Table 87 below.

Table 87 List of all wildlife species known or suspected to occur in the Elk Bugs and Fuel Analysis Area.

(Impact may occur in more than one column depending upon alternative.)

| Species | No Impact | Beneficial Impact | May Impact Individuals | May Impact Population |
|--------------------------------|------------------|--------------------------|-------------------------------|------------------------------|
| Bald eagle | All | | | |
| Northern goshawk | Alt 1 | | Alt 2, 3, 4 | |
| Black-backed woodpecker | Alt 1 | | Alt 2, 3, 4 | |
| Northern 3-toed woodpecker | Alt 1 | | Alt 2, 3, 4 | |
| Lewis' woodpecker | Alt 1 | | Alt 2, 3, 4 | |
| Pygmy nuthatch | Alt 1 | | Alt 2, 3, 4 | |
| Flammulated owl | Alt 1 | | Alt 2, 3, 4 | |
| Golden-crowned kinglet | All | | | |
| Marten | Alt 1 | | Alt 2, 3, 4 | |
| Townsend's big-eared bat | All | | | |
| Fringed-tailed myotis | Alt 1 | | Alt 2, 3, 4 | |
| Cooper's Rocky Mt. snail | Alt 1 | | Alt 2, 3, 4 | |
| Cockerell's striate disc snail | All | | | |
| Northern leopard frog | Alt 1 | | Alt 2, 3, 4 | |
| Tiger salamander | Alt 1 | | Alt 2, 3, 4 | |
| Pale milk snake | Alt 1 | | Alt 2, 3, 4 | |
| Black Hills red-bellied snake | Alt 1 | | Alt 2, 3, 4 | |
| Tawny crescent | All | | | |

Consultation with U.S. Fish and Wildlife Service

Due to determinations of “no effect” for all federally listed species potentially occurring within the project area, no consultation with U.S. Fish and Wildlife Service is necessary.

Management Indicator Species (MIS)

White-tailed deer, Mule deer, and Elk

The project area currently supports herds of both white-tailed deer and elk, with mule deer being rare in much of the area. Numbers of white-tailed deer have declined in the Black Hills since the middle 1970s (Griffin et al. 1994). Mule deer populations have also declined during the period 1997-2001, while elk populations on the Black Hills National Forest have shown notable increases during the period 1997-2001 (USFS WWW 2002).

The project area currently supports herds of both white-tailed deer and elk, with mule deer being rare in much of the area. Numbers of white-tailed deer have declined in the

Black Hills since the middle 1970s (Griffin et al. 1994). Diminished habitat quality has been implicated as a primary cause of deer reductions since fawn production and recruitment remain low (Anderson 1998, Deperno et al. 2000). Deperno et al. (2002) implicated the general lack of shrubs on the landscape as a factor contributing to deteriorated deer habitat and recommended that aspen regeneration and prescribed burning be applied to improve habitat quality. Sieg and Severson (1996) stated that the value of stands with 80 to 120 square feet of basal area is minimal as deer summer range habitat, and recommend aspen regeneration and thinning pine to low densities followed by underburning as techniques for improving forage quality and quantity.

The project area lies within deer and elk summer range. Current habitat conditions in the project area include 53% of the ponderosa pine cover type in moderate or high density mature stands with no viable forage in the understory. Open understory pine stands currently total 25% of the same cover type. Hardwood stands are slowly transitioning to conifer as more pine becomes established. Ponderosa pine are also encroaching into meadows not treated for pine removal in past vegetation management projects. Cover in the form of 3C and 4C stands constitutes 31% of ponderosa pine acres, and open road densities average just above 3 miles per square mile. Existing habitat suitability would remain unchanged under alternative 1.

Treatments under the action alternatives would remove encroaching pine from hardwood stands and meadows, regenerate some aspen stands, reduce ponderosa pine stand densities, enhance the grass/forb/shrub component by underburning, and reduce mileage of open roads. Open understory ponderosa pine would increase from 25% under the no-action alternative to 31%, 32%, and 32% of ponderosa pine acres under alternatives 2, 3, and 4, respectively. Table 88 displays the acres of big game habitat improvement activities and open road densities by alternative.

Table 88 Habitat Improvement Activities and Road Densities.

| Treatment | Alt 1 | Alt 2 | Alt 3 | Alt 4 |
|-------------------------------|--------------|--------------|--------------|--------------|
| Prescribed burn (ac.) | 0 | 339 | 4852 | 2943 |
| Hardwood maintenance (ac.) | 0 | 323 | 323 | 323 |
| Meadow maintenance (ac.) | 0 | 0 | 229 | 0 |
| Patch cutting* (ac.) | 0 | 0 | 594 | 0 |
| Open road density (mi/sq. mi) | 3.1 | 2.3 | 2.4 | 2.4 |

* The intent of this prescription is to create habitat diversity within monocultures of young regenerating pine stands. Treatments include removing all trees within an area 2-10 acres within a given treatment stand. Patch cuts would equal approximately 25% of acreage within a given treatment stand, and would not exceed 30% of stand acreage. More than one patch cut may be created within a treatment stand. Treatment of residual slash in patch cuts would include one or more of the following applications: lop and scatter, pile and burn, prescribed burn.

*Up to 30% of 594 acres of prescribed non-commercial thinning will have scattered patch cuts of 10 acres or less.

All action alternatives would reduce available cover to 29%, 29%, and 28% in the ponderosa pine cover type for alternatives 2, 3, and 4, respectively. However, Alternative 2 would reduce open road densities to 2.3 miles per square mile, while alternatives 3 and 4 would reduce open roads to 2.4 miles per square mile.

Habitat Effectiveness Index

Habitat effectiveness is an area's capability to support elk or deer based on amount and spatial distribution of forage, cover, and open roads. Habitat effective values are based on a score of 0-1000 with higher values representing more effective habitat. Revised Forest Plan standards and guidelines state minimum habitat effectiveness values that apply to Management Areas 3.31, 3.32, 5.1, 5.2a, and 5.4, all of which occur within the project area.

Habitat effectiveness values were calculated for the above Management Areas (Table 89). Management Areas 5.1(general forest) and 5.4 (deer winter range) comprise the majority of project area acres (88%).

Table 89 Habitat Effectiveness Values by Alternative

| | Habitat Effectiveness Values (%) | | | | |
|------------------|----------------------------------|--------------|-------|-------|-------|
| | Forest Plan Minimum | Alternatives | | | |
| | | | Alt 2 | Alt 3 | Alt 4 |
| Elk (summer) | | | | | |
| MA 3.31 | 40.0 | 47.5 | 47.5 | 47.5 | 47.5 |
| MA 3.32 | 39.0 | 61.9 | 60.1 | 58.5 | 59.5 |
| MA 5.1 | 43.0 | 57.6 | 58.1 | 58.2 | 58.1 |
| MA 5.2A | 40.0 | 58.7 | 56.6 | 56.0 | 56.7 |
| MA 5.4 | 54.0 | 56.8 | 58.3 | 58.0 | 58.1 |
| Elk (winter) | | | | | |
| MA 3.31 | 35.0 | 37.0 | 37.0 | 37.0 | 37.0 |
| MA 3.32 | 36.0 | 62.2 | 55.5 | 59.4 | 54.7 |
| MA 5.1 | 34.0 | 52.0 | 51.0 | 52.0 | 51.0 |
| MA 5.2A | 35.0 | 57.7 | 54.9 | 54.4 | 54.7 |
| MA 5.4 | 47.0 | 52.0 | 52.0 | 52.1 | 51.5 |
| WT Deer (summer) | | | | | |
| MA 3.31 | 37.0 | 40.3 | 40.3 | 40.3 | 40.3 |
| MA 3.32 | 41.0 | 45.5 | 49.7 | 46.0 | 49.2 |
| MA 5.1 | 40.0 | 52.6 | 53.1 | 53.3 | 53.2 |
| MA 5.2A | 37.0 | 52.6 | 50.5 | 50.4 | 50.6 |
| MA 5.4 | 45.0 | 50.1 | 51.2 | 51.4 | 51.0 |
| WT Deer (winter) | | | | | |
| MA 3.31 | 33.0 | 36.3 | 36.3 | 36.3 | 36.3 |
| MA 3.32 | 35.0 | 55.2 | 49.7 | 52.8 | 49.0 |
| MA 5.1 | 35.0 | 48.3 | 47.5 | 48.5 | 47.5 |
| MA 5.2A | 33.0 | 52.1 | 49.5 | 49.0 | 49.3 |
| MA 5.4 | 46.0 | 47.4 | 47.5 | 47.7 | 47.0 |

As shown above, habitat effectiveness index (HEI) values are currently above the minimum guidelines for all species and seasons (alternative 1). All action alternatives meet Forest Plan standards by maintaining habitat effectiveness above minimum thresholds in each management area (MA). Within MA 5.1, alternative 3 maintains the highest HEI for all species and seasons. Alternative 1 equals the HEI for alternative 3 in the elk/winter classification. Results for MA 5.4 vary by zone and alternative with Alternative 2 reaching the highest HEI for the elk/summer classification, while alternative 3 shows the highest HEI for all other species/seasons. No difference in HEI occurred in MA 3.31. In MA 3.32, alternative 1 shows the highest HEI for 3 species/seasons, with alternative 2 showing highest HEI for deer/summer. Alternative 1 also showed the highest HEI in all four categories within MA 5.2a.

The action alternatives would reduce open road densities from an existing 3.1 miles per square mile to approximately 2.4 miles per square mile. The planning team determined that further decreases were not possible at this time for the following reasons:

1. Private land access needs to be retained. Approximately 15,605 acres of land in other ownership is intermixed with National Forest System land, and other private parcels are adjacent to the project area.
2. Relatively flat terrain in much of the project area makes effective closure of certain roads especially difficult or expensive.

Merriam's Turkey

Turkey populations in the Black Hills increased dramatically since weather conditions number to a low in 1995 (USDA WFW 2002). Turkey habitat consists of a mix of structural stages in all cover types. All alternatives retain structural stage mixes that assure suitable habitat within the project area. Roosting habitat will be maintained throughout the project area for all alternatives since no overstory removal is proposed.

Brown Creeper

Habitat consists of dense mature coniferous (pine and spruce, 4B, 4C, 5), mixed deciduous woodlands, especially old growth forests. Nests under loose bark of dead trees > 10" dbh. Winters in more open stands.

Brown creeper occurs in low abundance throughout the Black Hills (Panjabi 2003).

Alternative 1 would have no impact. Existing dense stands (53% of ponderosa pine cover type) would remain unchanged, with short-term snag increases due to the current mountain pine beetle epidemic. However, the project area currently shows a lack of large trees as well as late and old forest structure (currently 47 acres of structural stage 5) across the landscape. Existing dense stands (4B and 4C) may be used by this species, but the optimum habitat is identified as old growth (structural stage 5). Without treatments to release some denser stands, the rate at which structural stage 5 is developed on the landscape would be very slow.

All action alternatives would reduce availability of potential habitat, with remaining habitat at 45% of pine acres for alternatives B, D, and F. No treatments are proposed in structural stage 5 stands.

Since commercial thinning, as proposed in this project, emphasizes retention and release of larger trees, growth rates in these trees would be more rapid than if the stand were left untreated. Thus, the action alternatives would create short-term losses in habitat availability, but if at least a portion of these stands were managed for late and old

structure in the future, optimal habitat (structural stage 5) would be available on the landscape much sooner than under alternative 1.

With an emphasis in the Black Hills toward thinning stands to reduce insect, disease, and wildfire risk, the trend of habitat availability for this species is likely to be downward, at least in the short-term. However, recently modified Forest Plan standards that require habitat retention for big game, marten, and goshawk, as well as minimum retention levels of snags and green tree replacements are expected to prevent habitat loss that affects populations at the planning area level. A lack of stand-altering treatments in structural stage 4C and 5 stands ensures that existing suitable habitat is maintained in the project area.

Mountain Lion

An estimated 40-50 breeding adult lions occur on the Black Hills National Forest (USFS WWS 2002). Treatments that benefit deer and elk, a main prey species, are likely to benefit mountain lion. Improved big game habitat effectiveness under the action alternatives indicates better habitat for deer and elk. Mountain lion denning habitat is scattered throughout the project area and would not be affected by any alternative. Reduced open road densities under all action alternatives are expected to benefit mountain lions.

Mountain Goat

There is no suitable habitat for mountain goats within the project area.

Other Species

American Dipper (*Cinclus mexicanus*)

This species is known to occur in Spearfish Creek, and distribution is likely very isolated. Distribution and trend information derived from breeding bird surveys (BBS) and Christmas bird counts (CBC) do not provide sufficient data to establish forest-wide trends for this species (Anderson 2002). South Dakota Department of Game and Fish established a dipper monitoring route along Spearfish Creek in 1993. Annual survey results vary widely mainly due to winter severity and the introduction of nest boxes in 2001 (Backlund 2003). Backlund (1994) found dippers in Spearfish Creek, Iron Creek, Little Spearfish Creek, East Spearfish Creek, and Whitewood Creek. Dippers are normally found associated with cold, fast-flowing, rocky streams with high water quality. Habitat is considered streams, banks, and streamside habitat since nests

are no more than a meter from water (Backlund 2003). They prefer a stream bottom with rocks, sand, and rubble (Anderson 2002).

Stream sedimentation, dams, water pollution, wildfire, severely cold winter, loss of stream flow due to diversion.

Upland treatments within the project area are within drainages that feed into several streams where dipper could potentially occur, including Bear Butte, Elk, and Whitewood Creeks. Backlund (2003) describes Whitewood Creek adjacent to the project area as having environmental problems that preclude the stream from being considered good long-term habitat. He also states that Bear Butte Creek did not historically support dippers, but nesting birds have been reported below Galena. Dippers were originally reported from Elk Creek in 1874. Backlund describes Elk Creek as poor habitat due to high levels of sedimentation and low flows.

Treatments, including timber harvest, noncommercial thinning, prescribed burning, road decommissioning, road reconstruction, and new road construction are proposed within the Whitewood, Bear Butte Creek, and Elk Creek drainages. Soils in this area are classified as moderate to high potential for erosion (see Soils/Hydrology section of the EA), so there is potential for management activities to cause additional sediment delivery to stream systems. However, application of mitigation measures, Forest Plan standards and guidelines, and Best Management Practices related to roads and timber harvest, is likely to minimize sediment delivery as well as minimize potential impacts to water quality (see Soils/Hydrology section of the DEIS) and dipper habitat.

Project activities are not expected to affect water flow regimes. No increase in pollutants into any water system is expected as a result of project activities. No impact to stream morphology or potential nesting substrate is expected. Due to a lack of potential impact to dipper habitat that is apparently already degraded, no negative impacts to potential habitat would occur. No negative impacts to local American dipper populations are expected.

Cumulative Effects of Public Law 107-206 Activities Outside the Project Boundary

The cumulative effects area outside the project boundary includes an additional 45,642 acres of National Forest land and 6,124 acres of other ownership. This area includes the Beaver Park Roadless Area and Surrounding Area described in Civil Action No. 99-N-2173 Settlement Agreement, Exhibit A2, and an additional five 7th order watersheds, which encompass activities undertaken due to Public Law 107-206.

Fire suppression and mountain pine beetle control are activities that have shaped vegetation on the Black Hills over the past 120 years. In comparison to historical conditions, today's ponderosa pine stands are more dense and extensive, leading to loss of meadows due to encroachment, reductions in hardwood stands, and declines in open pine habitat (USDA 1996).

Existing vegetation within this area is shown in Table 90, and consists of ponderosa pine (97%), aspen (0.6%), birch (0.1%), and white spruce (2%). Habitat structural stages for ponderosa pine include 64% of pine acres in mature condition, 32% in younger age classes, and 4% in grass, forb, or shrub. Moderate and high density mature stands (4B and 4C) total 45% of all pine acres, while open mature stands (4A) total 19% of pine acres.

Treatments in recently planned timber sales will decrease stand density on approximately 15% of the ponderosa pine cover-type. Treatments that regenerate aspen and pine will occur on less than 1% of the area. Table 91 shows expected acreages of vegetation cover types and habitat structural stages after planned treatments are implemented. Mature pine falls slightly to 62% of pine acres. The amount of moderate and high density pine stands drop to 34% of pine acres, while open mature pine increases to 28%. Management actions reduce white spruce acres by 10%, increase aspen by 76%, and increase the grass cover type by 73%. No structural stage within any cover type is completely removed by management actions.

Table 90 Existing Habitat Structural Stages, Cumulative Effects Area

| COVER | HABITAT STRUCTURAL STAGE (acres) | | | | | | | | | |
|---------------|----------------------------------|-------|-------|-------|-------|-------|-------|--------|---|--------|
| TYPES | 1 | 2 | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Totals |
| Grass | 343 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 343 |
| Aspen | 5 | 211 | 0 | 0 | 0 | 40 | 40 | 0 | 0 | 296 |
| Birch | 0 | 0 | 0 | 35 | 0 | 19 | 13 | 0 | 0 | 67 |
| Pine | 608 | 1,030 | 2,095 | 4,335 | 7,501 | 8,207 | 8,064 | 11,772 | 0 | 43,612 |
| Spruce | 0 | 0 | 43 | 56 | 0 | 508 | 168 | 71 | 0 | 846 |
| Totals | 957 | 1,243 | 2,138 | 4,426 | 7,501 | 8,774 | 8,285 | 11,843 | 0 | 45,167 |

Table 91 Post-Treatment Habitat Structural Stages, Cumulative Effects Area

| COVER | HABITAT STRUCTURAL STAGE (acres) | | | | | | | | | |
|---------------|----------------------------------|-------|-------|-------|-------|--------|-------|-------|---|--------|
| TYPES | 1 | 2 | 3A | 3B | 3C | 4A | 4B | 4C | 5 | Totals |
| Grass | 593 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 593 |
| Aspen | 18 | 204 | 204 | 0 | 0 | 74 | 22 | 0 | 0 | 522 |
| Birch | 0 | 0 | 0 | 35 | 0 | 19 | 13 | 0 | 0 | 67 |
| Pine | 918 | 2,051 | 3,693 | 3,982 | 5,740 | 12,058 | 6,519 | 8,261 | 0 | 43,222 |
| Spruce | 0 | 0 | 43 | 56 | 0 | 446 | 144 | 71 | 0 | 760 |
| Totals | 1,530 | 2,257 | 3,940 | 4,073 | 5,740 | 12,597 | 6,698 | 8,332 | 0 | 45,167 |

Threatened, Endangered, or Sensitive Species

As a result of management actions, impacts to threatened, endangered, sensitive, or management indicator species that may occur within the analysis area are expected to vary. No impact to bald eagle would occur due to a lack of nesting habitat. Habitat for species associated with moderate and high density pine stands, including northern goshawk, black-backed and three-toed woodpecker, and brown creeper, would decline. However, due to the relatively large amount of potential suitable habitat remaining within the analysis area, impacts are not likely to cause a trend toward federal listing or loss of viability.

Species associated with open stands of mature ponderosa pine, including pygmy nuthatch, flammulated owl, and Lewis' woodpecker, are likely to benefit from increased acres of potential suitable habitat. Species that rely on meadow habitat (loggerhead shrike, regal fritillary butterfly) are also expected to benefit due to increases in suitable habitat. Species with less specialized habitat requirement (smooth green snake, Black Hills red-bellied snake) may be affected individually, but no trend toward federal listing or loss of viability is expected. Other species for which suitable habitat would not be affected (Townsend's big-eared bat, fringe-tailed myotis, northern leopard frog), would have no impacts.

Suitable habitat for marten (white spruce) would decrease slightly. Due to the relatively minor reduction, no trend toward federal listing or loss of viability is expected.

Management Indicator Species (MIS)

No cumulative impacts to Merriam's turkey, mountain lion, or mountain goat are expected due to a lack of impact on suitable habitat. Cumulative impacts to brown creeper are discussed above.

Management actions are expected to have some impact on habitat suitability for big game. Habitat Effectiveness (HEI) values were calculated for the cumulative effects area by species, season, and management area (MA). The results are shown in Table 92.

Table 92 Habitat Effectiveness Indices, Cumulative Effects Area.

| | HABITAT EFFECTIVENESS | |
|------------------|-----------------------|------------|
| | Existing | Cumulative |
| Elk (summer) | | |
| MA 3.32 | 568 | 579 |
| MA 4.1 | 584 | 626 |
| MA 5.1 | 526 | 529 |
| MA 5.4 | 564 | 575 |
| Elk (winter) | | |
| MA 3.32 | 568 | 594 |
| MA 4.1 | 584 | 645 |
| MA 5.1 | 478 | 475 |
| MA 5.4 | 551 | 544 |
| WT Deer (summer) | | |
| MA 3.32 | 065 | 200 |
| MA 4.1 | 128 | 481 |
| MA 5.1 | 500 | 501 |
| MA 5.4 | 435 | 495 |
| WT Deer (winter) | | |
| MA 3.32 | 450 | 477 |
| MA 4.1 | 467 | 543 |
| MA 5.1 | 454 | 450 |
| MA 5.4 | 498 | 506 |

Treatments notably increase HEI within MA 3.32 and MA 4.1 for deer/summer and elk/summer habitats. Habitat effectiveness within MA 5.1 showed little change after treatment for all seasons and species. Cumulative treatments in MA 5.4 increased HEI for all species/seasons except elk/winter. Treatments within the cumulative effects area outside the project area exceed minimum HEI values or improve existing values currently below levels established by Phase 1 Amendment for all management areas, species, and seasons. Therefore, treatments in this area meet Forest Plan standards for big game.

Fisheries

Affected Environment:

Existing Condition

There are seven 6th Level Watersheds within the Elk Bugs and Fuels planning area and aquatic cumulative effects area. Whitewood Creek, Sandy Creek and Slaughterhouse Gulch are located in the Whitewood Creek Watershed (86-01). Bear Butte Creek, Park Creek, Butcher Gulch, Ruby Gulch, Lost Gulch, Vanocker Creek, Deadman Gulch, Strawberry Creek, Boulder Creek, and Two-Bit Creek are located in the Bear Butte Creek Watershed (87-01). Spring Creek is located in the North Spring Creek Watershed (87-02). Alkali Creek is located in the Upper Alkali Creek Watershed (90-01). Elk Creek, Virkula Gulch, Dry Elk Creek, and Meadow Creek are located in the Elk Creek Watershed (88-01). Little Elk Creek is located in the Little Elk Creek Watershed (88-02). Hay Creek is located in the Upper Boxelder Creek Watershed (89-01). Morris Creek, Forbes Gulch, Pleasant Valley Creek, Breakneck Gulch, Tilford Creek, Bulldog Creek, and Syndicate Gulch are located in the North Pleasant Valley Creek Watershed (88-05).

South Dakota has assigned a minimum beneficial use of wildlife propagation, stock water and irrigation to all streams. Page III-72, 1996 Black Hills National Forest, Forest Plan FEIS defines South Dakota stream classes and beneficial uses as follows:

- Class 1-Domestic water supply
- Class 2-Coldwater permanent fish life propagation waters
- Class 3-Coldwater marginal fish life propagation waters
- Class 7-Immersion recreation waters
- Class 8-Limited contact recreation waters
- Class 9-Wildlife propagation/stock watering/irrigation*
- Class 10-Irrigation*

The following Table 93 shows designated Stream Class and Beneficial Uses for within the proposed project area. The table includes the names of all perennial and intermittent streams in the study area listed in the Forest Plan or the 2002 South Dakota 305(b) list. It also shows if streams are meeting their beneficial uses where data exists.

Table 93 Beneficial Use Designation

| Stream | Segment | Beneficial Uses |
|------------------|---|---------------------------|
| Alkali Creek | From I 90 to S4, T4N, R5E | 1,3,8,9,10 |
| Bear Butte Creek | Headwaters to Strawberry | 2(P),8(F),9(F),10(F) |
| | Strawberry Creek to near Bear Den Mountain – Overall use full support | 2(F),8(F),9(F),10(F) |
| Boulder Creek | From Bear Butte Creek to Two Bit Creek | 3,8,9,10 |
| Elk Creek | | 2,7,8,9 |
| Meadow Creek | From Elk Creek to S25, T4N, R4E | 3,8,9,10 |
| Park Creek | From Bear Butte Creek to S11, T4N, R4E | 3,8,9,10 |
| Strawberry Creek | Headwaters to Mouth | 3(P),8(F),9(N),10(N) |
| Two-Bit Creek | From Boulder Creek to S11, T4N, R4E | 3,8,9,10 |
| Vanocker Creek | From Bear Butte Creek to S32, T5N, R5E | 3,8,9,10 |
| Whitewood Creek | Spruce Gulch to Sandy Creek | 2(P),7(N),8(U),9(F),10(F) |
| | Sandy Creek to I-90 | 3(P),7(F),8(F),9(F),10(F) |

* Class 9 and 10 denote a difference between the Forest Plan and the State of South Dakota. The Forest Plan defines Class 9 as wildlife propagation/stock watering/irrigation. The State defines Class 9 as Fish/Wildlife Prop/Rec/Stock and places irrigation in Class 10.

F=Fully supportive of assigned use (1 - 10% of values violate standards)

P=Partially supportive of assigned use (11 - 25% of values violate standards)

N=Non-support of assigned use (>25% of values violate standards)

U=Unknown

From a watershed management perspective, the sediment yield from a basin is important because 80 percent of water quality degradation results from erosion. Sediment interacts strongly with other water quality components, and sediment yield is directly affected by land-use activity (Kohler et al 1993). Sediment can smother the spawning and rearing habitat of trout and reduce aquatic invertebrates thereby affecting food availability.

Because of the density of area roads, many of which are adjacent to or cross stream channels, roads are the greatest source and delivery system of sediment to channels (Forest Plan Appendix K 1996). Even disturbed areas far from the drainage system may contribute to sediment if they are connected to the stream by roads, skid trails, ditches or cattle trails. Generally the harvesting of timber itself is not a serious source of soil disturbance. Surveys support the view that improperly located roads and skid trails, and

roads and trails without proper drainage rather than the actual harvesting of timber are the greatest cause for concern (Megahan 1975).

The South Dakota Department of Game, Fish and Parks (SDGFP) classify each of the streams by their trout populations based on a 1984-1986 Classification System. The classification system is explained below:

Wild Brook Trout Fisheries:

BKT1: Number of eight inch or greater brook trout exceeds 150/acre.

BKT2: Number of eight inch or greater brook trout is between 25 and 150/acre.

BKT3: Number of eight inch or greater brook trout is less than 25/acre.

Wild Brown Trout Fisheries:

BNT1: Number of eight inch or greater brown trout exceeds 150/acre.

BNT2: Number of eight inch or greater brown trout is between 25 and 150/acre.

BNT3: Number of eight inch or greater brown trout is less than 25/acre.

Wild Rainbow Trout Fisheries:

RBT1: Number of eight inch or greater rainbow trout exceeds 150/acre.

RBT2: Number of eight inch or greater rainbow trout is between 25 and 150/acre.

RBT3: Number of eight inch or greater rainbow trout is less than 25/acre.

Table 94 SDGFB Stream Classifications

| Stream | SDGFP Classification | Other |
|----------------------|---|----------------------------|
| Bear Butte Creek | BKT1, BKT2, BKT3, BKT1/RBT3, BKT2/RBT3 | Mountain Sucker present |
| Hay Creek | BKT2 | |
| Strawberry Creek | BKT3 | Mountain Sucker present |
| Elk Creek | BNT3/BKT1, BNT2/BKT1 | Mountain Sucker present |
| Two Bit Creek | BKT2 | |
| Two Bit Creek W Fork | BKT2 | |
| Whitewood Creek | BNT1/BKT3, BNT3/BKT3 | Mountain Sucker present |
| Meadow Creek | BKT2 | Mountain Sucker present |

Management Indicator Species Present in the Project Area

The 1997 Revision to the Forest Land and Resource Management Plan identified one aquatic habitat type to use as MIS and the Phase 1 Amendment identified 5 Aquatic Management Indicator Species that are representative of the aquatic communities within the Black Hills National Forest. Selection of these species was based on criteria set forth in the 1982 planning regulations that implement the National Forest Management Act, including the ability to predict changes in their populations in response to management activities.

The following Table 95 details species that may be present in the project area and potentially affected by the proposed management activities:

Table 95 Aquatic Management Indicator Species

| Taxa | Scientific Name | Common Name | Potentially Affected |
|------|---------------------------------|-----------------|----------------------|
| Fish | <i>Salmo trutta</i> | Brown Trout | Y |
| Fish | <i>Salvelinus fontinalis</i> | Brook Trout | Y |
| Fish | <i>Phoxinus neogaeus</i> | Finescale Dace | N |
| Fish | <i>Catostomus platyrhynchus</i> | Mountain Sucker | Y |
| Fish | <i>Couesius plumbeus</i> | Lake Chub | N |

The species and habitat that could be potentially affected by this project will be addressed in detail in the Analysis of MIS Effects section.

Finescale Dace

Finescale dace is a species native to the Black Hills National Forest. It prefers cool spring-fed bogs, small, weedy, sluggish streams, creeks and lakes (Ashton and Dowd 1991). It is sometimes associated with beaver ponds. It is currently protected under Black Hills Management (South Dakota Fishing Handbook 2001). It is sensitive to sedimentation of ponds and pools, reduced oxygen, and increased water temperature (McDowell 1996). Finescale dace occur in artesian springholes off of the Forest and selected stream reaches/reservoirs in Wyoming that are outside of the watersheds affected by the proposed action. According to the Black Hills National Forest 2001 Monitoring Report for Management Indicator Species, data suggest the historic distribution of finescale dace was limited to streams and spring-fed lakes and bog holes in the Redwater Creek drainage at the northern extent of the Black Hills. Finescale dace have disappeared from four of the six sites where previous collections have been made in South Dakota. According to survey data, Finescale dace does not occur within the project area or its cumulative effects boundary.

Lake Chub

Lake chub is a species native to the Black Hills National Forest. It prefers cool streams and lakes, but will inhabit virtually any body of water, standing or flowing, large or small. Most commonly found in gravel-bottomed pools and runs of streams and along rocky lake margins (Backlund 1996). It is possibly sensitive to introduction of trout and exotics, but more likely sensitive to decline of streams and streamside vegetation caused by decline of water yield due to increased forest coverage and overuse of riparian areas by livestock causing loss of riparian vegetation and widening of streams (Backlund 1996). It is also possibly affected by fire suppression, due to a decline in water yield, and overgrazing (Simpson and Erickson 1998). According to the Black Hills National Forest 2001 Monitoring Report for Management Indicator Species, the only remaining population of lake chub on the Forest occurs in Deerfield Reservoir, where populations have declined in abundance since 1994. Catch rates from 1997 to 2000 were approximately one-sixth the catch rates from 1994 through 1996. Deerfield Reservoir is not located within the project area or its cumulative effects boundary.

Mountain Sucker

Mountain suckers are native to the Black Hills National Forest. They occur in lakes, but most often prefer cold, clear mountain streams with temperatures between 13° and 23°C and moderately swift water velocities (Smith 1966; Sigler and Sigler 1996). Research indicates that mountain suckers occur only in the downstream sections of a stream where channel gradients are lowest and temperatures are warmer than upstream areas suitable only for trout (Gard and Flittner 1974). Underwater observations made by Decker (1989) revealed that Mountain suckers were always found on the stream bottom, usually occurred in small groups, and were closely associated with cover (e.g., exposed willow or tree root masses, undercut banks, log jams, and boulders). They occur most often near the transitions between pools and runs (Hauser 1969; Decker 1989). Riffle habitats are rarely used, except for spawning (Hauser 1969; Wydoski and Wydoski 2002).

Mountain suckers are benthic feeders. Their diet consists mainly of simple plants like diatoms, green algae, and blue-green algae, but small invertebrate animals are also ingested. They are considered spring spawners, but the exact timing varies across the geographic range—probably in response to local variations in water temperature

Mountain suckers occur in much of western North America from Nevada, Utah, and eastern California and north to British Columbia, Alberta, and Saskatchewan. Mountain sucker populations in the Black Hills are the eastern-most extension of the species (Isaak et al. 2003).

Early surveys indicate that mountain suckers were widely distributed in streams across the Black Hills. Recent stream surveys suggest that mountain suckers occur in much of the historic Black Hills range (Isaak et al. 2003). Density estimates derived with a closed-population, removal-estimator methodology (Zippin 1958) exist in the South Dakota

portion of the Black Hills. South Dakota Game, Fish and Parks personnel routinely collect this information during stream surveys. Based on the most recent set of surveys (Meester 1993 – 1999), mountain sucker densities ranged from 7 to 13,399 fish/ha, with an average of 1,262 fish/ha and a median of 265 fish/ha for 59 sites where this species occurred. Comparison of the early distribution of mountain suckers in the Black Hills with the recent distributions suggests that changes over the last century have been minimal (Isaak et al 2003). According to the Black Hills National Forest 2001 Monitoring Report for Management Indicator Species, no trends in mountain sucker population densities were observed for four stream sites that were repeatedly sampled in the 1990s, suggesting stability within the core of its range.

The wide distribution and high abundance of mountain suckers at many sites in the Black Hills, even after more than a century of intensive land use, suggests that current risks for this species are minimal (Isaak et al 2003). Therefore, land use activities and impacts to stream habitats would have to deviate strongly and on a forest-wide scale from historic and current norms before mountain sucker populations would be jeopardized (Isaak et al 2003). The South Dakota Natural Heritage Database now tracks the mountain sucker. It is ranked S3 (*either very rare and local throughout its range in the state, or found locally in a restricted range in the state, or vulnerable to extinction throughout its range in the state because of other factors*) (Erickson 2002).

Of the streams surveyed within the project area from 1992 through 2000, mountain sucker were found in Bear Butte Creek, Elk Creek, Meadow Creek, Strawberry Creek and Whitewood Creek. Table 96 below shows the streams surveyed and average population of Mountain Sucker where they occurred in these streams.

Table 96 Average Mountain Sucker Populations

| Stream | Year | # of Sites Surveyed | # of Sites with Mt. Sucker | Average # of Mt. Sucker per Acre |
|----------------------|------|---------------------|----------------------------|----------------------------------|
| Bear Butte Creek | 1992 | 4 | 4 | 860 |
| | 1993 | 4 | 3 | 1863 |
| | 1995 | 1 | 1 | 1245 |
| | 1997 | 3 | 3 | 1572 |
| | 2000 | 7 | 7 | 1017 |
| Elk Creek | 1993 | 1 | 1 | 3128 |
| | 1997 | 2 | 2 | 3059 |
| Hay Creek | 2000 | 1 | 0 | NA |
| Meadow Creek | 1995 | 1 | 1 | 197 |
| | 1998 | 1 | 1 | 1205 |
| Strawberry Creek | 1998 | 1 | 0 | NA |
| | 2000 | 2 | 1 | 134 |
| Two Bit Creek | 1997 | 1 | 0 | NA |
| | 1998 | 3 | 0 | NA |
| Two Bit Creek W Fork | 1997 | 1 | 0 | NA |
| Whitewood Creek | 1994 | 1 | 1 | 1634 |
| | 1997 | 2 | 1 | 124 |
| | 1998 | 3 | 3 | 762 |

| Stream | Year | # of Sites Surveyed | # of Sites with Mt. Sucker | Average # of Mt. Sucker per Acre |
|----------------------|------|---------------------|----------------------------|----------------------------------|
| Bear Butte Creek | 1997 | 3 | 3 | 1572 |
| | 2000 | 7 | 7 | 1017 |
| Elk Creek | 1997 | 2 | 2 | 3059 |
| Hay Creek | 2000 | 1 | 0 | NA |
| Meadow Creek | 1998 | 1 | 1 | 1205 |
| Strawberry Creek | 1998 | 1 | 0 | NA |
| | 2000 | 2 | 1 | 134 |
| Two Bit Creek | 1997 | 1 | 0 | NA |
| | 1998 | 3 | 0 | NA |
| Two Bit Creek W Fork | 1997 | 1 | 0 | NA |
| Whitewood Creek | 1997 | 2 | 1 | 124 |
| | 1998 | 3 | 3 | 762 |

*Average number of mt sucker per acre was calculated by taking the number of mt sucker found at each survey location within the project area and dividing by the total number of survey sites. If mt sucker were not found at a survey site, that site was not included.

Brown Trout

Brown trout are an important game species, which are not native to the Black Hills (Black Hills of South Dakota Fishing Guide 2000). They are widely stocked but also reproduce naturally. They prefer clear, cold stream headwaters and lakes, although they can survive in deeper, warmer, slower waters than other trout. Temperatures of 22□-28□C are lethal and non-turbid waters are required for egg survival. Management practices with adverse effects include reduction of shade over water, channelization and sedimentation (Biota Information System of Mexico).

Of the streams surveyed within the project area from 1992 through 2000, Brown trout were found in Elk Creek and Whitewood Creek. Table 97 below shows the streams surveyed and the average population of Brown trout where they occurred in these streams.

Table 97 Average Brown Trout Populations

| Stream | Year | # of Sites Surveyed | # of Sites with Brown Trout | Average # of Brown Trout per Acre |
|------------------|------|---------------------|-----------------------------|-----------------------------------|
| Bear Butte Creek | 1992 | 4 | 0 | NA |
| | 1993 | 4 | 0 | NA |
| | 1995 | 1 | 0 | NA |
| | 1997 | 3 | 0 | NA |
| | 2000 | 7 | 0 | NA |
| Elk Creek | 1993 | 1 | 1 | 7 |
| | 1997 | 2 | 2 | 68 |
| Hay Creek | 2000 | 1 | 0 | NA |
| Meadow Creek | 1995 | 1 | 0 | NA |
| | 1998 | 1 | 0 | NA |
| Strawberry Creek | 1998 | 1 | 0 | NA |
| | 2000 | 2 | 0 | NA |
| Two Bit Creek | 1997 | 1 | 0 | NA |
| | 1998 | 3 | 0 | NA |

| Stream | Year | # of Sites Surveyed | # of Sites with Brown Trout | Average # of Brown Trout per Acre |
|----------------------|------|---------------------|-----------------------------|-----------------------------------|
| Two Bit Creek W Fork | 1997 | 1 | 0 | NA |
| Whitewood Creek | 1994 | 1 | 1 | 713 |
| | 1997 | 2 | 2 | 818 |
| | 1998 | 3 | 3 | 335 |
| Bear Butte Creek | 1997 | 3 | 0 | NA |
| | 2000 | 7 | 0 | NA |
| Elk Creek | 1997 | 2 | 2 | 68 |
| Hay Creek | 2000 | 1 | 0 | NA |
| Meadow Creek | 1998 | 1 | 0 | NA |
| Strawberry Creek | 1998 | 1 | 0 | NA |
| | 2000 | 2 | 0 | NA |
| Two Bit Creek | 1997 | 1 | 0 | NA |
| | 1998 | 3 | 0 | NA |
| Two Bit Creek W Fork | 1997 | 1 | 0 | NA |
| Whitewood Creek | 1997 | 2 | 2 | 818 |
| | 1998 | 3 | 3 | 335 |

*Average number of brown trout per acre was calculated by taking the number of brown trout found at each survey location within the project area and dividing by the total number of survey sites. If brown trout were not found at a survey site, that site was not included.

Brook Trout

Brook trout are an important game species introduced to the Black Hills (Black Hills of South Dakota Fishing Guide 2000). They need cold, clean headwater streams and lakes. They are sensitive to water temperatures above 20°C for extended periods of time and degraded water quality including low pH, low dissolved oxygen, and sedimentation. Brook trout spawn on gravel and cobble. The eggs are susceptible to mortality from sediment. Management activities that cause changes in brook trout habitat include livestock grazing in riparian zones, channelization and sediment from roads and other ground-disturbing activities (Biota Information System of New Mexico).

Of the streams surveyed within the project area from 1992 through 2000, brook trout were found in Bear Butte Creek, Elk Creek, Hay Creek, Meadow Creek, Strawberry Creek Two Bit Creek, Two Bit Creek West Fork, and Whitewood Creek. Table 98 below shows the streams surveyed and the average population of brook trout where they occurred in these streams.

Table 98 Average Brook Trout Populations

| Stream | Year | # of Sites Surveyed | # of Sites with Brook Trout | Average # of per Acre |
|------------------|------|---------------------|-----------------------------|-----------------------|
| Bear Butte Creek | 1992 | 4 | 4 | 193 |
| | 1993 | 4 | 2 | 18 |
| | 1995 | 1 | 1 | 27 |
| | 1997 | 3 | 3 | 108 |
| | 2000 | 7 | 7 | 795 |
| Elk Creek | 1993 | 1 | 1 | 69 |
| | 1997 | 2 | 2 | 1779 |
| Hay Creek | 2000 | 1 | 1 | 828 |

| Stream | Year | # of Sites Surveyed | # of Sites with Brook Trout | Average # of Brook Trout per Acre |
|----------------------|------|---------------------|-----------------------------|-----------------------------------|
| Meadow Creek | 1995 | 1 | 0 | NA |
| | 1998 | 1 | 1 | 308 |
| Strawberry Creek | 1998 | 1 | 0 | NA |
| | 2000 | 2 | 2 | 1076 |
| Two Bit Creek | 1997 | 1 | 1 | 4731 |
| | 1998 | 3 | 1 | 5544 |
| Two Bit Creek W Fork | 1997 | 1 | 1 | 3804 |
| Whitewood Creek | 1994 | 1 | 0 | NA |
| | 1997 | 2 | 2 | 51 |
| | 1998 | 3 | 3 | 21 |
| Bear Butte Creek | 1997 | 3 | 3 | 108 |
| | 2000 | 7 | 7 | 795 |
| Elk Creek | 1997 | 2 | 2 | 1779 |
| Hay Creek | 2000 | 1 | 1 | 828 |
| Meadow Creek | 1998 | 1 | 1 | 308 |
| Strawberry Creek | 1998 | 1 | 0 | NA |
| | 2000 | 2 | 2 | 1076 |
| Two Bit Creek | 1997 | 1 | 1 | 4731 |
| | 1998 | 3 | 1 | 5544 |
| Two Bit Creek W Fork | 1997 | 1 | 1 | 3804 |
| Whitewood Creek | 1997 | 2 | 2 | 51 |
| | 1998 | 3 | 3 | 21 |

*Average number of brook trout per acre was calculated by taking the number of brook trout found at each survey location within the project area and dividing by the total number of survey sites. If brook trout were not found at a survey site, that site was not included.

Instream Fisheries Habitat

Instream fisheries habitat includes those factors associated with the biological, physical and chemical environment of a stream that affect both quality and quantity of fisheries habitat. Such factors include water temperature, pH, total dissolved solids, total suspended solids, sediment, bank stability, ground cover, streambed type and others. Factors relevant to this project are analyzed in both the hydrology section of the EIS, and the following fisheries effects analysis.

Proposed, Endangered, Threatened and Sensitive Species (PETS)

The Black Hills National Forest maintains lists of species that require special consideration during project planning. All PET species (USFWS designated) and those that occur on the Regional Forester's Sensitive Species list were considered during the initial evaluation of the Proposed Project. There are no Proposed, Threatened, Endangered, Sensitive aquatic species within the project area or its influence.

Environmental Consequences:

Analysis of MIS Effects

Brook trout, brown trout, mountain sucker and Instream Fisheries Habitat are all similarly affected by the proposed activities, therefore, effects presented below apply to all fisheries resources within the project area. There is no habitat suitable for either finescale dace or lake chub within the project area nor has their presence been indicated by surveys.

Instream Fisheries Habitat

Instream fisheries habitat includes those factors associated with the biological, physical and chemical environment of a stream that affect both quality and quantity of fisheries habitat. Such factors include water temperature, pH, total dissolved solids, total suspended solids, sediment, bank stability, ground cover, streambed type and others. Factors relevant to this project are analyzed in both the hydrology section of the EIS, and the following fisheries effects analysis.

Direct and Indirect Effects

Alternative 1 – No Action

The No Action alternative will have no direct effects on fisheries resources. Indirect effects would occur because existing roads would continue to contribute erosion at the current rate. No new roads would be built, but no existing roads would be decommissioned.

Alternatives 2, 3 & 4

Timber harvest, bait and sanitation cutting, and non-commercial thinning will have no direct effects on fisheries. None of these activities will occur within stream channels, and riparian corridors will be protected through the implementation of mitigation measures (See Appendix B). Although water yields may increase, they are not expected to be significant. Refer to the Stream Flow Regime discussion in the Hydrology section for a description of potential water yield changes.

Prescribed burns will occur over a portion of the watershed but will have no direct effects on fisheries. Indirect effects will vary due to fire intensity, aspect and slope, and all burns remove some degree of forest floor cover. Exposure of bare mineral soil may occur during prescribed burns but is not a common occurrence and is rarely extensive in area. Prescribed fire will also occur in riparian corridors as fire backs to the edge of streams used as firelines, but these fires are rarely intense and typically top-kill only the smallest streamside vegetation because of the high humidity near watercourses. The reduction in leaf litter and herbaceous plants and plant remains may result in the potential for increased sedimentation and enhanced nutrient content of river water. Water yield will likely increase slightly due to reduced transpiration and raindrop interception by herbaceous plants.

Construction of prescribed burn fuel breaks will have no direct effects on fisheries. Indirect effects include removal of vegetative cover and exposure of minerals soil that will result in increased erosion and possible sedimentation of streams. The placement of fireline water control structures (water bars) will reduce the velocity of water moving along firelines and encourage the sediment load to be dropped before reaching streams. In addition, the construction of turnouts at the end of water bars that terminate in leaf litter outside the burn area also helps filter runoff and reduces the potential degradation of water quality. Fuel breaks constructed within riparian or buffer zones that result in reduction of forest canopy can reduce shade and affect stream temperature, cover, primary production and habitat (Belt et al 1992). Bank erosion and lateral channel migration can also contribute sediments if protection vegetation and living root systems are removed. Summer stream temperature increases due to the removal of riparian vegetation has been well documented (Belt et al 1992). Measurements by Hewlett and Fortson (1983) under winter conditions also indicate that removal of riparian vegetation can reduce temperatures by about 10°C. Effects to stream temperature can be reduced by retaining a large portion of the shade-providing trees within the buffer zone.

Construction of temporary roads, skid trails and log landings will have no direct effects on fisheries. Indirect effects will include the removal of vegetative cover and soil disturbance as these areas are established, shaped and drainage structures installed. These activities have the potential to increase sedimentation, concentrate runoff, and possibly alter surface and subsurface flow and potentially impact water quality. The potential for sedimentation will be reduced by surfacing these roads with gravel, re-vegetating exposed soils outside the needed roadbed, establishing sedimentation traps in drains leading to streams and not establishing roads within streamside corridors. Road closures would have beneficial effects on the fisheries by increasing the streamside vegetation and streambank stability and decreasing sediment transport.

Fisheries resources within the project area are dependent upon high water quality levels and low levels of siltation. Forest Plan standards and guides and Best Management Practices that have established specific protective buffer zones for streams will provide protection for these species' habitat during timber harvest, associated silvicultural activities, and prescribed fire (see Appendix B). The construction of temporary roads and skid trails may have a temporary impact immediately downstream from crossings by silting in egg masses during the rearing season. However, this effect may be mitigated by the use of large cobble rocks at stream crossings which hold up well under traffic, prevent muddying of the water and serves as suitable substrate for juveniles and hatchlings to hide in after the timber sale has closed. In the event more permanent structures are needed, preference would be given to low water concrete slabs and open box culverts, properly installed.

Potential supplies of sediment are a function of the number of miles of roads and the predominant surface type within 300 ft of streams, the amounts of road proposed for decommissioning and construction, and the amount of prescribed burning proposed by

alternative and the access of material to the stream. Alternative 3 has the highest potential for associated erosion issues and Alternative 2 has the least. Effects due to sedimentation and vegetation disturbance associated with harvest are expected to be minimal through the application of BMP's, Forestwide Standard and Guides for Soil, Water, and Riparian zones. (See Appendix B).

Cumulative Effects

Alternative 1 – No Action

The No Action alternative will have no cumulative effects on fisheries.

Alternatives 2, 3, & 4

Cumulative effects will include the incremental increase in indirect effects as additional units are harvested during the timber harvest contract period, typically 3 years total. However, as units are harvested in the second year, those units harvested the first year will have already begun recovery of forest floor vegetation and ground litter from cast leaves and needles. This overlapping process of loss and recovery of ground cover and forest floor vegetation between years will continue post harvest.

Cumulative effects of additional water yield on water quality due to timber harvest and prescribed burning will be short lived. A flush of herbaceous ground cover occurs due to increased sunlight levels. Associated transpiration rates and rain interception surfaces will also increase.

Impacts on water quality and yield from prescribed fire activity will not be additive to those impacts from timber harvest because they will occur as temporally separate events. If there are effects on water quality from prescribed fire it will be temporally distinct, occurring after timber harvest sites have begun recovery through vegetative re-growth. The effects of sequential prescribed burns within the watershed will depend upon their locations and distances from intermittent and perennial streams, but overlap of indirect effects (incremental increases) will probably occur. As with timber harvest, the first areas of prescribed burning will have begun vegetative recovery before subsequent areas are burned, with effects on water quality expected to last only for one to two growing seasons after the last burn has been achieved. Long-term effects on mountain sucker or its habitat beyond the life of the current action are not anticipated because of swift terrestrial vegetative recovery and natural flushing of stream systems through normal rain events.

Potential cumulative effects of firelines on water quality with regard to fisheries will be greatly reduced due to mitigation measures in place, and revegetation of firelines following burns. Indirect effects of fireline construction on water quality may be additive with respect to subsequent fireline construction and burns. This will depend upon

location of burns and associated firelines, quality of fireline and water bar construction, rate of re-vegetation and accumulation of leaf litter. Indirect effects of fireline construction will not be additive to timber harvest that will have recovered prior to fireline construction and burning. Because firelines are often located on slopes and involve exposure of mineral soil, they have the potential for long-term effects on water quality. Mountain sucker and its habitat may be affected if firelines are improperly constructed. These effects may occur within the watershed and downstream.

The cumulative effects of construction of temporary roads, skid trails and log landings should be minimal since the total acreage of disturbance is small for roads and a few additional acres for skid trails and landings. Most of these areas will be closed at project conclusion. Unlike firelines, the potential for long-term effects on water quality and fisheries habitat are not anticipated.

South Dakota Department of Game, Fish and Parks stocks lakes and streams within the Black Hills National Forest with nonnative fishes for purposes of recreational angling, including brown trout, brook trout and rainbow trout. While there is little data regarding the relationship between these introduced species and mountain sucker, mountain sucker may be an important prey species when abundances are high. Decker and Erman (1992) noted an inverse relationship between brown trout and mountain sucker abundance in Sagehen Creek. They suggest that mountain sucker were either avoiding reaches with high numbers of brown trout or that brown trout were consuming mountain sucker where their distributions overlapped. According to Isaak et al. (2003), predation is a plausible mechanism by which brown trout and brook trout may be impacting mountain suckers. Cumulative effects from proposed activities and stocking of trout on mountain sucker are expected to be minimal due to implementation of the project design criteria, Forest Standards and Guidelines, Region 2 Water Conservation Practices, and South Dakota Best Management Practices.

Cumulative Activities

Past, Present and Reasonably Foreseeable Future Actions

Past Actions

Past actions in the project area on National Forest, private, and other lands include timber harvest, wildland fuel management, fire suppression, grazing, mining, gravel production, recreation, firewood cutting, big-game management, road construction, railroad construction, subdivision of private lands and home construction, utility line construction and maintenance.

Boomer Timber Sale EA 2000

The acres treated are estimated at 600-700 acres. The treatments included shelterwood prep cuts, seed cuts and overstory removal. Commercial thinning, POL thinning and group selection treatments were also done. Some areas received special cuts that removed the pine to enhance hardwood stands. This project included Strawberry Creek and Bear Butte Creek, which are also found within or adjacent to the Elk Bugs and Fuel project area.

Grizzly Gulch Fire

The Grizzly Gulch Fire of June and July of 2002 burned 11,589 acres of which 3,315 are National Forest. Almost half of this fire, 5,608 acres, burned within the Elk Bugs and Fuel project boundary; 3,025 acres of National Forest lands and 2,583 acres of other ownership. National Forest lands within the project area that burned were mostly forest vegetation, with ponderosa pine, aspen, or aspen-birch cover types. Vegetation mortality followed levels of fire severity. Mortality of trees on National Forest lands within the project area was mostly low to moderate, with high mortality, greater than 60%, on approximately 240 acres (Garbish, B 2002). Areas of high mortality were pine stands on steep, rugged slopes with little or no past treatment. No commercial timber salvage is planned on National Forest lands. Salvage is occurring on BLM managed lands and private lands.

Present Actions

Peak EA timber harvests and related treatments, 2002

This project includes commercial treatments of 1151 acres and restoration treatments on 460 acres. Wildlife habitat improvements will take place on 164 acres. This project includes Whitewood Creek and its tributaries, which is also within or downstream from the Elk Bugs and Fuel project area.

Grizzly Gulch Fire-Salvage and Hazard Tree Removal- 2002-ongoing

This is a BLM Project to remove dead trees killed in the 2002 Grizzly Gulch Fire. This is occurring on BLM lands adjacent to main road up Spruce Gulch to top of ridge, estimated 5 miles, and harvesting dead trees within reach of the road or within tractor slope. Acres salvaged are estimated at 300-600 acres.

Future Actions

BLM Wildland-Urban Interface Project, 2003

This project will include Whitewood Creek and its tributaries, which is also within or downstream from the Elk Bugs and Fuel project area.

Mineral EA, 2003

This project will occur directly adjacent to the southwest side of the Elk Bugs and Fuel project area. Both the Mineral project and the Elk Bugs and Fuel project will impact Whitewood Creek and Bear Butte Creek and its tributaries. No impacts to fisheries are expected to occur in this project as long as BMP's and mitigation measures are followed.

Legislated Activities

Legislated activities within the project area include non-commercial treatments in the Forbes Gulch area and fuel breaks along the boundaries inside of Beaver Park. Approximately 3,372 acres of activities would occur within the project boundary.

Effects from the Cumulative Activities

The majority of land within this watershed is federal land managed by the U.S. Forest Service. Resource management emphases (forest management) on these adjacent lands administered by the U.S. Forest Service are unlikely to change, and will continue to offer plants and animals a variety of forest types, successional stages, and structural diversity in virtual perpetuity. The U.S. Forest Service has no control over those lands managed by state, local, other federal agencies, or private landowners. It is likely that some ground disturbing activities will take place on these lands in the future. Some of these activities have the potential to impact some species in a positive or negative manner, particularly if those activities affect water quality.

Cumulative effects from ongoing activities on lands managed by the Forest Service are expected to be minimal due to the implementation of the Forest Standards and Guidelines, Region 2 Water Conservation Practices, and South Dakota Best Management Practices.

Irreversible and Irretrievable Commitments of Resources

No irreversible or irretrievable commitments of fisheries resources would occur with implementation of any action alternative.

Management Requirements

Construct roads and other disturbed sites to avoid sediment discharge into streams and wetlands.

Keep heavy equipment out of streams, swales, and lakes and their tributaries except to cross at designated points to avoid adding sediment.

Route road drainages through the streamside management zone (SMZ), filtration fields, or other settlement settling structures to trap sediment and prevent its entry into a stream.

"All instream work will be accomplished in January, February, March, July, August, or December, which is outside fisheries MIS spawning seasons."- is this mitigation?

Sensitive Plants

Affected Environment:

The majority of the project area is forested with a ponderosa pine (*Pinus ponderosa*) over-story. Ponderosa pine dominates the ridge tops and xeric slopes. The xeric pine dominated areas are not habitat for R2 Sensitive plants and most species of Interest (some are found on limestone cliffs among dry pine types, not areas planned for treatment). Most stands have been managed in the past by thinning and regeneration cutting. Paper birch (*Betula papyrifera*), ironwood (*Ostrya virginiana*), aspen (*Populus tremuloides*), and Black Hills spruce (*Picea glauca*) are found in the moister areas, often between meadow and upland forest types, along small drainages, and along eastern and northern aspects as co-dominant species or occur locally within another plant community type. Meadows, riparian vegetation, and mined-over lands are also present within the project boundary. Using the habitat type classification presented in *The Nature Conservancy's- Black Hills Community Inventory* (Marriott 2000) the plant community types for the Elk Bugs and Fuels project area would include:

Upland Forests and Woodlands – *Pinus ponderosa*/*Juniperus communis*; *Pinus ponderosa*/*Symphoricarpos*; *Pinus ponderosa*/*Mahonia repens*: and some *Pinus ponderosa*/*Prunus virginiana* and *Pinus ponderosa*/*Quercus macrocarpa* along the eastern portions of the project area.

Upland shrubs- *Juniperus horizontalis*/*Schizachrium scoparium* (lower Vanocker creek area).

Sparse Vegetation Plant Community – *Pinus ponderosa*/Limestone Cliff Sparse Vegetation.

Riparian/Wetland Communities – *Salix exigua* Temporarily Flooded Shrubland; *Symphoricarpos occidentalis* Shrubland; *Betula papyrifera*/*Corylus cornuta* Forest; *Salix bebbiana* Shrubland; and *Glyceria grandis*/*Poa palustris* Mixed Herbaceous Black Hills Herbaceous Vegetation.

The geomorphic Central Core, Limestone Plateau, and elements of the Minnelusa (Minnekahta limestone) Foothill geomorphic regions are represented within the Elk Bugs and Fuels Project area (Larson 1999). Topography of the project area varies from steep rugged terrain (rim rock and rocky outcrops), to gentle rolling hills. The varied geomorphology of the project area create small areas (less than 5 acres) of mixed

community types and areas that may be classified as additional types if they were larger in size. These areas are difficult to classify and are not listed due to limited size, distribution, and importance across the project area.

Several perennial creeks flow from the project area including Elk creek, Vanocker creek, Beaver gulch, Tilford gulch, Forbes gulch, Bulldog gulch, Alkali creek, Deadman gulch, Bear Butte creek, and Boulder creek. Other named and unnamed creeks and springs are located throughout the project area. Many of these creeks support wet meadows, riparian vegetation, and plant communities with paper birch/aspen/Black Hills spruce dominant or present.

All species that could be reasonably expected to occur in the Elk Bugs and Fuels Project area can be found in Section II of the Biological Evaluation for R2 Sensitive plants. For the species specific 'Risk Assessment' refer to Appendix C of the Biological Evaluation located in Section C.2.5 of the Project File.

Information about the status of plants in the project area was derived from historic plant occurrence information (pre-2002) and field information gathered in 2002. Surveys for R2 Sensitive plants and plant Species of Interest in 2002 were limited to suitable habitats. Rainfall in 2002 was below average, resulting in plants drying up earlier in the season than usual. The dry year coupled with later than usual surveying created a situation where only high probability habitats could be confidently identified. Approximately 3,800 acres of occupied or field verified suitable high probability R2 Sensitive/Species of Interest plant habitats have been identified near areas of proposed actions (field verified from the Arcview Hillshade command mapping indication of likely Sensitive plant habitat areas). Habitats encountered during survey include a few Habitats of Interest such as springs, seeps, and one unverified unusual occurrence of lodgepole pine (*Pinus contorta*). Those habitats have been included in the GIS mapping exercise as areas to avoid during planning for the Elk Bugs and Fuels Project. All of the 3,800 acres are outside of any proposed actions in all alternatives of the Elk Bugs and Fuels Project.

Sensitive Plant Occurrences in the Project Area:

No U.S. Fish and Wildlife Service (USFWS) Federally listed plant species occur in the Black Hills. Of the twelve R2 Sensitive species with high probability habitat in the project area, seven species were found within the project area. The seven R2 Sensitive plant species with occurrences in the Elk Bugs and Fuels Project area are the American trailplant/pathfinder (*Adenocaulon bicolor*), northern arnica (*Arnica lonchophylla*), tawny sedge (*Carex alopecoidea*), long-stalk sedge (*Carex pedunculata*), treelike clubmoss (*Lycopodium dendroideum*), marsh muhly (*Muhlenbergia glomerata*), and bloodroot (*Sanguinaria canadensis*). All of these species are found in moist forest habitats.

A new occurrence of *Botrychium campestre* (a R2 Sensitive species, 2003 occurrence) was recently located in the Black Hills about east of the project area in Wyoming. This occurrence is the first documented within the Black Hills in about 30 years. Information about its biology, ecological requirements, and its tolerance to disturbance in the Black Hills are not fully understood.

Table 99 Black Hills National Forest (BHNF) R2 Sensitive Plant Species

| Code | Scientific Name | Common Name | SD State Rank | WY State Rank | Global Rank | Black Hills Habitat |
|-------|---------------------------------|---------------------|---------------|---------------|-------------|---|
| ADBI | <i>Adenocaulon bicolor</i> * | American trailplant | S2 | S1 | | Moist shaded forests with a hardwood component. Often in aspen/hazelnut and birch/hazelnut woods, on north-facing slopes and in small drainages. Elevation range 3,940-6,200 feet. |
| ARLO5 | <i>Arnica lonchophylla</i> * | Northern arnica | SU | | G4? | Located in dry to moist partially shaded conifer, hardwood and mixed stands. Elevation range 3,700-6,300 feet. |
| BOCA5 | <i>Botrychium campestre</i> | Prairie moonwort | SR | S1 | G2 | Sandy grasslands. Distribution in the Black Hills is not well understood. One historic population known from the Bearlodge Mountains, WY and one new 2003 occurrence in the northern Black Hills. |
| CAPE4 | <i>Carex pedunculata</i> * | Long-stalk sedge | S2 | NA | G5 | Typically found on rich loamy soil on north, east, and west - facing slopes, terraces and stream banks. Prefers moist deciduous/conifer forests. Elevation range 3,800-6,100 feet. |
| EQSC | <i>scirpoides</i> | Dwarf scouring-rush | S2 | S1 | G5 | Shaded, damp habitats along streams and on terraces in white spruce and birch woods. Elevation range 4,150-5,500 feet. |
| LYCO3 | <i>Lycopodium complanatum</i> | Trailing clubmoss | S1 | S1 | G5 | Found on shaded, north facing slopes in white spruce/paper birch forest, often in moist side drainages. Elevation range 5,000-5,820 feet. |
| | <i>Lycopodium dendroideum</i> * | Treelike clubmoss | S2 | S1 | G5 | facing slopes, side drainages and ravines. Associated with spruce and hardwoods. Elevation range 4,100-5,540 feet. |
| MUGL3 | <i>Muhlenbergia glomerata</i> * | Marsh muhly | SU | S1 | G4 | Habitats range from pine and spruce dominated open forest with a hardwood component to ledges and slopes along creeks; and open, grassy hardwood draw |

| Code | Scientific Name | Common Name | SD State Rank | WY State Rank | Global Rank | Black Hills Habitat |
|--------|---------------------------------|-------------------------|---------------|---------------|-------------|---|
| | | | | | | bottoms. Elevation range 4,160-6,000 feet. |
| PLOR4 | <i>Platanthera orbiculata</i> | Large round-leaf orchid | S1 | S1 | G5? | Found on shady, north-facing slopes in birch/hardwood stands, and occasionally in conifer forests on damp, rich, humus soil. Elevation range 4,350-6,150 feet. |
| SASE2 | <i>Salix serissima</i> | Autumn willow | S1 | S1 | G4 | Fens and wet meadows. Known from McIntosh fen and along the Middle Fork of Boxelder Creek |
| SACA13 | <i>Sanguinaria canadensis</i> * | Bloodroot | S4 | | G5 | Typically found on floodplains, terraces, and north facing slopes of rich deciduous forests in leaf litter and loamy soil, occasionally coniferous forests. Elevation range 3,940-5,000 feet. |
| SCCY | <i>Scirpus cyperinus</i> | Cottongrass bulrush | S2 | S1 | G5 | Moist to saturated soils of forested stream banks and wetlands. Elevation range 4,200-5,600 feet. |

* Known within the project area.

Only R2 listed species with suitable habitat in the project area were analyzed in the Biological evaluation for the Elk Bugs and Fuels Project.

Another R2 Sensitive species, *Corallorhiza odontorhiza*, has not been documented in the Black Hills since 1971 (Lawrence County, South Dakota). An exact location has not been determined from the 1971 record and has not been successfully relocated to date (Ode pers. comm. 2000 as cited in USDA 2001). Despite surveys in the vicinity of the previous record in 2001 and surveys in other areas of the Black Hills for the species, *Corallorhiza odontorhiza* has not been found again. Although surveys are ongoing, *Corallorhiza odontorhiza* is currently not considered to be present in the Black Hills and is not evaluated in the risk assessment of the Biological Evaluation.

Other Species of Interest:

In addition to consideration of USFWS Federally listed and R2 Sensitive plant species, twenty-eight Species of Interest have been identified as present within the project area. These species appear on BHNH Species of Interest list (which includes plants that need more information about status, biology, and distribution), the State of South Dakota Department of Game, Fish, and Parks Natural Heritage Program list of Rare, Threatened, and Endangered Plants dated April 30, 2002 (SDDGFP List). The SDDGFP List includes plants that are rare and tracked in South Dakota. The table of plant Species of Interest represents the portion of the BHNH and SDDGFP lists having known occurrences in the Elk Bugs and Fuels Project area.

Table 100 BHNF Northern Zone Plant Species of Interest in the Project Area

| Species | Plant Code | | SD State Ranking* |
|---|------------|-------------|-------------------|
| <i>Asplenium trichomanes-ramosum</i> | ASTR10 | G5 | S3 |
| <i>Aquilegia brevistyla</i> ** | AQBR | G5 | SR |
| <i>Botrychium multifidum</i> | BOMU | G5 | S1 |
| <i>Botrychium virginianum</i> | BOVI | G5 | - |
| <i>Corallorhiza trifida</i> | COTR3 | G5 | S2 |
| <i>Carex eburna</i> ** | CAEB2 | G5 | - |
| <i>Carex granularis</i> var. <i>haleana</i> ** | CAGRH | G5/T4 | SR |
| <i>Cypripedium parviflorum</i> var. <i>pubescens</i> | CYPA19 | G5 | S3? |
| <i>Cynoglossum virginianum</i> var. <i>boreale</i> | CYVIB | G5T4T5 | - |
| <i>Disporum hookeri</i> (var. <i>oreganum</i>) | DIHO3 | G5 (G5T4T5) | - |
| <i>Elymus diversiglumis</i> (<i>E. interruptus</i>) | ELDI | G5 | - |
| <i>Elymus villosus</i> ** | ELVI | G5 | SR |
| <i>Gymnocarpium dryopteris</i> | GYDR | G5 | - |
| <i>Luzula acuminata</i> var. <i>acuminata</i> ** | LUACA | G5/T4/T5 | SU |
| <i>Luzula parviflora</i> | LUPA | G5 | SU |
| <i>Melica subulata</i> | MESU | G5 | S3 |
| <i>Moneses uniflora</i> | MOUN2 | G5 | - |
| <i>Orobanche uniflora</i> | ORUN | G5 | SU |
| <i>Pellaea gastonyi</i> ** | PEGA5 | G2G4 | SR |
| <i>Petrophyton caespitosum</i> | PECA12 | G4 | S4? |
| <i>Phleum alpinum</i> | PHAL2 | G5 | SU |
| <i>Pinus contorta?</i> (var. <i>latifolia?</i>)*** | PICO | G5 | - |
| <i>Polystichum lonchitis</i> ** | POLO4 | G5 | S1 |
| <i>Pyrola picta</i> | PYPI2 | G4G5 | S2 |
| <i>Sorbus scopulina</i> | SOSC2 | G5 | S4 |
| <i>Vaccinium membranaceum</i> ** | VAME | G5Q | S2 |
| <i>Viburnum lentago</i> | VILE | G5 | - |
| <i>Viburnum opulus</i> var. <i>americanum</i> ** | VIOPA2 | G5T5 | SR |

*Note: Some species may also be found on the Wyoming State Lists.

**On the BHNF Species of Interest list.

*** Identification not confirmed.

Environmental Consequences:

Studies of R2 Sensitive and Species of Interest plants and their habitats have not occurred. As a result, little about effects to these plants from disturbances are known. A conservative approach to avoid direct impacts to R2 Sensitive and Species of Interest plants and high probability habitats has been developed for this project. Indirect effects for the project are described by alternative, however it is generally assumed indirect effects from the proposed project are negative to R2 Sensitive and Species of Interest plants and their habitats unless treatments were specifically designed to benefit these species. These include the effects from noxious weed introduction and spread, soil movement, and increased livestock access to their habitats.

There are twelve species of R2 Sensitive plants with high probability habitat in the project area. Seven of those species (American trailplant/pathfinder (*Adenocaulon bicolor*), northern arnica (*Arnica lonchophylla*), tawny sedge (*Carex alopecoidea*), long-stalk sedge (*Carex pedunculata*), treelike clubmoss (*Lycopodium dendroideum*), marsh muhly (*Muhlenbergia glomerata*), and bloodroot (*Sanguinaria canadensis*) have known occurrences within the Elk Bugs and Fuels Project area. *Botrychium campestre* may occur within the Elk Bugs and Fuels Project area even after surveys for sensitive plants have been completed. Prolonged drought, limited understanding about the species, and the irregular nature that *Botrychium* sp. ferns appear in a given year above ground, make surveys for these species difficult. The known occurrence and the historic (1973) unrelocated occurrence are not found within the project area and the elevations of *Botrychium campestre* are generally below much of the elevation range of the Elk bugs and Fuels Project area. Due to habitat differences and large amount of high quality habitat set aside from project implementation direct impacts to *Botrychium campestre* are not expected.

Within the project area, twenty-eight other Species of Interest (*Agrimonia gryposepala*, *Asplenium trichomanes-ramosum*, *Aquilegia brevistyla*, *Botrychium multifidum*, *Botrychium virginianum*, *Corallorhiza trifida*, *Carex eburna*, *Carex granularis* var. *haleana*, *Cypripedium parviflorum* var. *pubescens*, *Cynoglossum virginianum* var. *boreale*, *Disporum hookeri*, *Elymus diversiglumis* (*E. interruptus*), *Elymus villosus*, *Gymnocarpium dryopteris*, *Luzula acuminata* var. *acuminata*, *Luzula parviflora*, *Melica subulata*, *Moneses uniflora*, *Orobancha uniflora*, *Pellaea gastonyi*, *Petrophyton caespitosum*, *Phleum alpinum*, *Pinus contorta*, *Polystichum lonchitis*, *Pyrola picta*, *Sorbus scopulina*, *Vaccinium membranaceum*, *Viburnum lentago*, and *Viburnum opulus* var. *americanum*) have known occurrences. Additional unknown occurrences may be present within the project area because only those areas proposed for treatments under the Elk Bugs and Fuels Project were surveyed for R2 Sensitive plants and suitable habitats in 2002. Approximately 3,800 acres of occupied R2 Sensitive plant and Species of Interest, and high probability habitats for these species have been identified near the proposed action areas. It is not likely that R2 Sensitive and Species of Interest plants occupy all 3,800 acres. However, all of these areas will be avoided during implementation of the Elk Bugs and Fuels Project.

Direct Effects Common to all Alternatives:

In the no action alternative, no direct effects to sensitive plant species are expected since ground disturbing activities are not proposed. In all action alternatives, known plant occurrences and high probability habitat for R2 Sensitive plant species and Species of Interest would be avoided during project implementation. Development of implementation maps from the current GIS layers for each emphasis area (transportation, wildlife, fuels, timber, etc.) would have areas to avoid and areas where on-site botany personnel are required during project implementation (for example where new roads are proposed close to protected high probability habitat areas). No direct effects are expected from any of the alternatives in the Elk Bugs and Fuels Project.

Indirect Effects from the No Action Alternative (Alternative 1):

Indirect effects from the no action alternative include long-range effects from wildfire in areas of untreated fuels accumulations. The R2 Sensitive plants, Species of Interest, and high probability habitats are generally more mesic portions of the landscape and historically do not burn as intensely as other areas. However without treatment of fuels, creation of fuel breaks, and the removal of bug-killed trees, fires in the future would likely be more intense and more widespread. The effects from a wildfire then can be expected to be greater than if fuels reduction activities had not taken place. These effects could include the reduction of canopy closure (which could be beneficial in pine types, and would be detrimental in hardwood types), short-term increases of erosion and available nutrients, increases in competing early seral vegetation, increases in livestock access, and increase of the risk of spread and introduction of noxious weeds. These effects could impact R2 Sensitive plants, Species of Interest and high probability habitats.

Indirect Effects common to all Action Alternatives (2, 3, and 4):

In all of the action alternatives, short-term increases in risks from the introduction and spread of noxious weeds from equipment used during implementation of the project as well as reductions of soil cover can be expected. Reductions of soil cover increases the risk of introduction that weeds can become established (Petroff 1999). Noxious weed infestations are a particular threat to R2 Sensitive plants, Species of Interest, and suitable habitats. Mitigations to prevent the introduction and spread of noxious weeds into the proposed treatment areas have been built into the project (including avoiding known infestations during project implementation and requiring equipment that operates off road be free from weeds and soil before coming to the project area) and will reduce the risk of negative indirect effects from noxious weeds on the R2 Sensitive plants and Species of Interest. Indirect effects from soil movement as a result of these activities are possible, but are expected to be short duration (i.e. less than 5 years). Movement of soil into occupied R2 Sensitive plant and Species of Interest occurrences and their habitats could affect them indirectly by changing their habitat. The effect of soil movement into R2 Sensitive plant and Species of Interest occurrences and high probability habitats could range from smothering and killing individuals to adding additional nutrients that could be either positive or negative indirect effects (additional nutrients may increase competition

from other species, or the additional nutrients may be beneficial). Removal of vegetation and trees in the fuels and silvicultural proposals would increase access for livestock across the project area. The effects from grazing and trampling of the R2 Sensitive plants and high probability habitats would be a negative indirect effect. Once the cattle have access to an area, repeated use could perpetuate the access and effects. These effects generally would be limited in scope and duration (small areas and less than 5 years or the duration of project implementation), but could affect individuals in the R2 Sensitive plant occurrences. Generally these effects are assumed by botanists to be negative effects.

Indirect Effects from Alternative 2

In this alternative, additional fuel breaks not surveyed in 2002 have been proposed. The importance of the fuel break treatment was developed too late in the project process to perform field surveys for botany. These additional treatments (from the proposed treatment areas developed during 2002) add approximately 737 acres. The areas within the additional proposed fuel break areas that are high probability R2 Sensitive plant and Species of Interest habitats would be surveyed prior to project implementation. Based on GIS mapping, approximately 107 acres of the additional proposed fuel break acres are mapped as high probability habitat and would be surveyed prior to project implementation. From past experience, areas outside of the 107 acres may become botany avoidance areas and some of the 107 acres may become available for treatments after field verification. Any R2 Sensitive and Species of Interest plants and high probability habitats located in the additional fuel break areas would be avoided.

Indirect Effects from Alternative 3

This alternative was developed emphasizing benefits to wildlife species over other resources. In general, treatments would be less intense or over fewer acres than the Modified Proposed Action (Alternative 2). As a result the expected indirect effects to R2 Sensitive plants, Species of Interest, and high probability plant habitats would be less than Alternative 2. As a part of Alternative 3, conifer (pine) removal and prescribed burning is proposed in and around meadows, which is expected to increase grass, forb, and shrub habitats preferred by wildlife. All of these areas are outside of R2 Sensitive plant and Species of Interest occurrences and high probability habitats. Removal of pine from the meadows could benefit R2 Sensitive plant species and Species of Interest by maintaining meadow/forest edge habitats by maintaining mesic habitat types. Indirect effects from soil movement as a result of these activities are possible, but expected to be of short durations (i.e. less than 5 years) and limited in scale.

Indirect Effects from Alternative 4

This alternative was developed to provide additional wildfire control in the urban interface areas. Four roads totaling 4.8 miles that are proposed for decommissioning in Alternatives 2 and 3 would not be decommissioned under this alternative. Removal of roads often has a short-term increase of soil movement, but a long-term benefit to ecosystems by reducing access areas for noxious weed vectors, reducing sediment

movement in the long-term, and reducing the effects from hydrologic changes which can negatively effect R2 Sensitive plants, Species of Interest, and suitable habitats. Additionally fuels treatments are proposed within a 200-foot radius survivable space zone around structures and a ½ mile radius wild-land/urban-interface zone of reduced fuels around all the inhabited structures in the project area. These treatments would be outside of all R2 Sensitive plants and Species of Interest occurrences and high probability habitats for these species. For these treatments to be effective, tree and vegetation removal would be greater than the treatments proposed to reduce the risk of pine beetle spread. Soil movement, risk of noxious weed introduction and spread, and access for livestock increases over Alternative 2 would be expected. As a result an increase of indirect effects to R2 Sensitive plants and Species of Interest and high probability habitats over Alternative 2 would be expected.

Cumulative Effects (Common to all Action Alternatives):

Planned projects to reduce fuels, reduce the risk/spread of pine beetle outbreaks, improve wildlife habitat, and improve firefighting conditions by creating fuel breaks are adjacent to the Elk Bugs and Fuels Project. Other projects in the Northern Black Hills such as the adjacent Mineral Forest Management Project have botany mitigations similar to the Elk Bugs and Fuels Project to prevent direct effects. Indirect effects from these projects are also expected to be similar to those described in the Elk Bugs and Fuels Project.

Adjacent to the Elk Bugs and Fuels project area are areas legislated by the United States Congress to treat for fuels. Previously known occurrences of R2 Sensitive plants and Species of Interest would be avoided during implementation of the treatments for the legislated areas. Other than avoiding previously known occurrences, these legislated areas are exempt from further botanical consideration and would likely have direct, indirect, and contribute to cumulative effects to R2 Sensitive plants, Species of Interest, and high probability habitats. In addition to the seven known R2 Sensitive plants and 30 Species of Interest present in the project area, occurrences of the R2 Sensitive species *Equisetum scirpoides* and the Species of Interest *Carex leptalea* and *Selaginella rupestris* are adjacent to the project area and are within the legislated treatment area (these occurrences would be avoided during project implementation). No new surveys for R2 Sensitive plants or high probability habitats would be performed for the legislated project areas. As a result, other occurrences in unsurveyed areas in the legislated project area may go undetected during project implementation and effects to those occurrences could include direct effects from driving on plants, burning plants, and removing suitable habitat for these species. The indirect effects could include changes in light regime by over story removal, soil movement on to occurrences (no buffers would exist like the Elk Bugs and Fuels and Mineral Forest Management Projects), changes to hydrology, increased access for livestock, and the introduction and spread of noxious weeds.

Efforts to prevent direct effects and limit indirect effects to R2 Sensitive plants Species of Interest and high probability habitats have been made in the design of the Elk Bugs and Fuels Project. This included developing the GIS layer used in the planning process that has approximately 3,800 acres of areas that were avoided during project design for all alternatives. Mitigations to prevent direct effects and reduce indirect effects include having a botanist present during on-the-ground road layout where new roads are planned near R2 Sensitive plants, Species of Interest, and high probability habitats, requiring equipment that operates off road be free from weeds, and surveying the additional fuel break areas for R2 Sensitive plants, Species of Interest, and suitable habitats prior to implementation and avoiding any R2 Sensitive plant and Species of Interest occurrences, and high probability habitats found during those surveys. For a complete and site-specific list of mitigations please refer to the Mitigations and Recommendations section of the Biological Evaluation located in Section C.2.5 of the Project File.

Direct and Indirect Effects R2 Sensitive Plant Species with Suitable Habitat in the Project Area and No Known Occurrences:

The five R2 Sensitive species that have suitable habitat in the project area (*Botrychium campestre*, *Equisetum scirpoides*, *Platanthera orbiculata*, *Salix serissima*, *Scirpus cyperinus*) may be present in areas that were not surveyed as a part of the 2002 surveys or are in the areas identified as high probability habitat. Occurrences of the seven R2 Sensitive species known to be in the project area also may have additional occurrences in areas that were not surveyed as a part of the 2002 surveys of proposed project areas or are in the areas identified as high probability habitat. No direct effects are expected as a result of implementation of this project. Off site indirect effects could be possible from noxious weed introduction, soil movement, and increased livestock access.

Conclusion:

Due to potential indirect and cumulative effects from the Elk Bugs and Fuels Project on R2 Sensitive plants the seven sensitive species present in the analysis area, American trailplant/pathfinder (*Adenocaulon bicolor*), northern arnica (*Arnica lonchophylla*), tawny sedge (*Carex alopecoidea*), long-stalk sedge (*Carex pedunculata*), treelike clubmoss (*Lycopodium dendroideum*), marsh muhly (*Muhlenbergia glomerata*), and bloodroot (*Sanguinaria canadensis*), and the R2 Sensitive species with habitat in the project area prairie moonwort (*Botrychium campestre*), dwarf scouring-rush (*Equisetum scirpoides*), trailing clubmoss (*Lycopodium complanatum*), large round-leaf orchid (*Platanthera orbiculata*), autumn willow (*Salix serissima*), cottongrass bulrush (*Scirpus cyperinus*) are assigned a determination of **“may adversely impact individuals but, not likely to result in a loss of viability in the planning area, nor cause a trend to federal listing or a loss of species viability range wide”** for all action alternatives.

The “may impact individuals...” rating is based on the fact that in depth studies about the R2 Sensitive plant species and their habitats have not been undertaken and indirect effects may occur from the Elk Bugs and Fuel Project. In addition cumulative effects to the R2 Sensitive plant species and their habitats are expected from other projects in the area as well as direct effects are expected from the adjacent legislated treatment areas.

For a more detailed description of Environmental Consequences and how they were developed, refer to the Elk Bugs and Fuels Project Biological Evaluation and the Elk Bugs and Fuels Project Botany Specialist Report in Section C 2.5 of the project file.

Rangeland

Affected Environment:

The proposed Elk Bugs and Fuel Project would encompass four active grazing allotments and four vacant allotments.

Active Allotments

The Bear Butte allotment consists of 18,597 acres and has 9 grazing permits. A total of 224 cow/calf pairs have a permitted season of use from June 10 to September 30 on a season long grazing system. There is no interior fencing and the allotment boundary is not fenced in most areas. The allotment is extremely dissected by private land, most of which is unfenced. Most of the permittees live on private land within the allotment, and turn their cattle out from their home ranch. This has resulted in small herds of stock grazing lands close to their respective home ranches, under an essentially season long system with all portions of the allotment subject to livestock grazing at any time during the grazing season.

A portion of Bear Butte creek is within the allotment. Bear Butte creek is a coldwater fishery with trout and the R2 Sensitive fish mountain sucker. Riparian vegetation is present within the allotment. Bear Butte creek is the most substantial stream providing a year-round cold-water trout fishery in the allotment. Fences, improvements, and water developments are found in this allotment.

The Runkle allotment is 13,874 acres in size of which 1,489 acres are private property. Permitted use is 128 cow/calf pairs with a season of use from June 16 to October 15. It is managed under a deferred rotation grazing system operated between the East and West grazing units. There is no interior fencing, and much of the allotment boundary is not fenced. As a result, the allotment is subject to unauthorized use by livestock from the adjacent allotment to the west (Bear Butte). The allotment has 16 water developments, 1 cattle guard and 2 miles of fence.

Most of the allotment is in the Elk Creek drainage, with minor portions in the Virkula, Forbes, Breakneck, and Tilford drainages. Elk creek is the most substantial stream

providing a year-round cold-water trout fishery and the R2 Sensitive species mountain sucker for about 7 miles of stream in the upper reaches of the allotment.

The Elk allotment is located in the very southeastern end of the project boundary. It is 16,853 acres in size of which 1,290 acres are private property. Permitted use is for 85 cow/calf pairs on a 4 unit deferred-rotation grazing system operating from June 1 to October 15. The allotment has 5 miles of fence, 3 cattle guards and 5 spring developments.

The allotment is within the Little Elk Creek, Elk Creek, and Stagebarn canyon drainages. Little Elk Creek is a perennial coldwater fishery with natural reproduction of brook trout. Approximately 1,422 acres of riparian habitat are within the allotment.

The Crook Mountain allotment is located 2 miles north of Deadwood, South Dakota and is bordered on the north and east by the National Forest boundary. It consists of 4,665 acres of National Forest land and 3,420 acres of private. Permitted use is for 28 cow/calf pairs under a season long grazing system from July 1 to September 20.

The allotment is within two major drainages. Whitewood creek is a permanent coldwater fishery that is recovering from historical damage from upstream mining and dumping. Trout and the R2 Sensitive species mountain sucker are present in the creek. Approximately 250 acres of riparian habitat with perennial or intermittent water are within this allotment.

The allotment has range improvements consisting of one mile of fence, two ponds and two springs.

Vacant Allotments

The Cave, Bulldog, Pillar Peak, and Polo Peak allotments are all vacant with no permitted use at this time.

Environmental Consequences:

The effects from implementation of the Elk Bugs and Fuels Project vary somewhat by alternative. The Elk Bugs and Fuels Project Proposed action does not have any proposals for range improvements. No negative effects are expected from the no-action alternative (Alternative 1). The available forage would remain at the current level and noxious weeds would continue to spread at the current rate. Only the action alternatives would have indirect effects upon the range condition of the project area. Changes to the range include increased livestock access across the landscape (except during project implementation), increases in primary and secondary (transitory) available forage, and

increased risk of introduction and spread of noxious weeds that can diminish range quality/available forage.

Effects common to all action alternatives

Direct effects from implementation of any of the action alternatives would include reduction of available forage for the season the treatment was implemented due to vegetative removal and limited access during project implementation. These are considered short-term effects (less than 5 years).

Indirect effects common to the action alternatives include reductions in risk of noxious weed spread from road decommissioning; increases in risk of the spread of noxious weeds in treatment areas left with mineral soil (such as skid trails and prescribed fire); and modest increases in available forage. In alternatives 2, 3 and 4 the proposals for commercial hardwood restoration, non-commercial hardwood restoration, and shaded fuel breaks are the same. Limited increases in secondary forage could be expected from the acres involved in those treatment areas. The total involved acreage of the hardwood restoration and shaded fuel breaks is less than 2,000 acres. In addition, 2,264-2,347 acres are proposed for non-commercial thinning (with underburn of the thinning areas on 642 acres in alternative 3 and 858 acres in alternative 4). Some additional grass and forb development would occur in the underburn portions of the units. Over the analysis area these would be a non-significant increase in forage (less than 2,500 acres over the 60,000-acre analysis area).

Between 56 and 62 acres of road decommissioning are proposed, depending on the alternative. Reductions in roads are generally considered a risk reduction benefit to the spread of noxious weeds. However, any reductions of weed invasion risk are overshadowed by the increased risk of weed spread due to the effects of the action treatments, especially the road construction and reconstruction, prescribed fire, and tree removal.

In general the indirect negative effects from the proposed actions are increased risk of noxious weed spread from ground disturbing activities, prescribed fire, and road construction/reconstruction. Beneficial indirect effects include increased access for livestock throughout the analysis area and increases in secondary forage. The amount of treatments are described by alternative below, in general the amounts of treatment areas between the alternatives are not significantly different in terms of the difference in risk from noxious weed introduction, increases in cattle access, or amount of forage that could be generated. Refer to Appendix B for the recommended mitigation.

Alternative 2

Approximately 8,100 acres are proposed for commercial and non-commercial thinning in this alternative. Increases in secondary forage in alternatives 2 and 4 from thinning are expected to be similar. Alternative 2 and Alternative 4 have the same proposed acreage (32 acres) for bait and sanitation thinning to reduce pine beetle populations, and no acres are proposed in Alternative 3. The least amount of prescribed burning is proposed for Alternative 2 (approximately 340 acres).

Alternative 3

This alternative was developed with emphasis for wildlife species. Less acreage is proposed for commercial and non-commercial treatments (approximately 6885 acres) than either alternative 2 or 4. Increase in secondary forage from thinning in alternative 3 is expected to be less than either alternative 2 or 4. In this alternative approximately 1,760 acres are proposed for prescribed burning.

Alternative 4

This alternative was formulated to emphasize fuel reduction in the wildland-urban interface. This alternative has the largest amount of acres to be treated (approximately 8,400 acres) with commercial and non-commercial thinning. In this alternative approximately 1,635 acres are proposed for prescribed burning.

In general most forage and livestock access would be generated under alternative 4. However, this alternative has a slightly higher risk of noxious weed introduction and spread than alternatives 2 or 3.

Cumulative Effects

Any negative effects on the range resource from this project would be minimal and no different than what has occurred in the past. Present and foreseeable future activities, including the legislated activities, are not likely to impose any negative effects than what has occurred in the past. Improvements in vegetation health will always benefit wildlife and livestock. The proposals in the Elk Bugs and Fuels Project have been developed to reduce the risk of catastrophic wildfire. Wildfire areas generally are good places for noxious weeds to become established. Once established, they often take over natural habitats and reduce the range quality. Unless effective mitigation measures are implemented for this project (see noxious weed mitigation measures in Appendix B) to control and limit the spread of known noxious weed infestations, they will continue to degrade range habitat. Any adjacent timber sales or future timber sales would only exacerbate the problem. This would result in continued displacement and fragmenting of native plant communities and degradation of range quality.

Noxious Weeds

Affected Environment:

Current inventory estimates a total of 933 acres of noxious weed infestation within the project area. Weed species consist of leafy spurge (140 acres), spotted knapweed (173 acres), Canada thistle and hounds tongue (420 acres combined); scattered occurrences of St. Johnswort, musk thistle and wooly mullein and one small occurrence of teasel (located during the 2002 field surveys for rare plants).

The analysis area is well roaded, providing good vector access for spreading noxious weeds. The numerous occurrences of noxious weeds in the analysis area (coupled with the variety of species) further exacerbate the potential for spread of noxious weeds via road use (from cars/trucks, off highway vehicles, recreationists, wildlife and livestock). The analysis area has approximately 16,000 acres of private property that may also have noxious or invasive exotic weeds present. Activities on these lands or the egress to and from them also add to the risk for the spread and introduction of noxious weeds. Four active range allotments are present within the analysis area. The use of weed infested forage for livestock and other aspects of livestock management can add to the risk of noxious weed spread and invasion.

Environmental Consequences:

It is estimated that 80% of the lands administered by the Black Hills National Forest are infested with varying populations of noxious weeds. Soil disturbing activities associated with timber sales typically encourage the establishment and spread of noxious weeds. Left untreated, these weeds will continue to spread and result in establishment of new weed populations in adjacent areas. Historically, disturbed areas such as roads, skid trails, landings, and burn piles are most susceptible to infestation. The Purpose and Need, and Proposed Action list methods of vegetation treatment requiring specific mitigation. The mitigations are listed in Appendix B. Mitigations were obtained from the Black Hills National Forest Noxious Weed Management Plan and are the general weed prevention guidelines for site disturbing projects. Guidelines for noxious weed management specific to prescribed fire, timber harvest operations and road maintenance and rehabilitation are also in the weed management plan and will need to be followed on a site-specific basis.

Table 101 Noxious Weed Risk Assessment

| Factors | Components | Variations | Risk |
|--|---|---|---|
| 1. Inventory | Site specific area, identify, map, estimate numbers/acres | Inventory complete for proposed project areas within the analysis area (other portions of the analysis area is GIS mapped for previously known occurrences). | Low |
| 2. Known noxious weeds | Number of A, B, or C-rated weeds, number of infestations, size | Leafy spurge, spotted knapweed, Canada thistle, hounds tongue, St. Johnswort, musk thistle, woolly mullein, and teasel are present in the area. | Prevention high priority; control high priority. Risk high due to presence in the area. |
| 3. Habitat vulnerability | Previous disturbance, plant cover, soil cover, shade, soil type, aspect/moisture. | The analysis area has experienced and continues to experience many disturbances. Historic grazing has occurred in the analysis area, the area has experienced historic timber harvest, and many open areas with little to no soil cover exist adjacent to the project area. | High risk. |
| 4. Non-project dependent vectors. | The project area is accessed by a well-maintained forest collector system. Unimproved roads include those used for fire and other infrastructure maintenance use. | There is a network of Forest Service Roads, non-system/unimproved roads, and private roads are in the vicinity. Recreation use is high in the area for hiking, camping, fishing, and hunting. Equestrian use also high in the area. | High risk. |
| 5. Habitat alteration expected as a result of project | Some of the project area could lose ground cover for several seasons. | Reduction of potential soil cover, but fuel reduction will improve the area in the long-term. | Low-moderate risk, dependant on short or long-term perspective. |
| 6. Increased vectors as a result of project implementation | Traffic increases. | Temporary spur roads/skid trails for equipment access would be created and obliterated after use. Traffic related to project implementation would increase. Up to 62 miles of road obliteration proposed. | Low risk overall. Moderate to high risk of weed infestation on temp. roads. Road closures beneficial to risk reduction. |

| Factors | Components | Variations | Risk |
|---|--|---|--|
| 7. Mitigation measures | Prevention (equipment washing, weed-free materials, monitoring), control (prompt action on small infestations), cultural practices (maintain shade, minimize disturbance, design project to reduce weed flow). | If project areas are located in known weed occurrences, require that those units be entered last in an area and wash equipment prior to moving to another location or off-forest ("C"-clause). Ensure equipment coming to the project area is free from weeds. Utilize weed free straw for erosion control. Utilize gravel from gravel pits (if gravel is needed) that have been inspected and do not have noxious weeds. | Low risk if completely implemented. |
| 8. Anticipated weed response to proposed action | Tally "high risk" responses in previous factors; consider mitigation if it is adopted as part of the proposed action. | If fully implemented, the mitigations should prevent the introduction/spread of noxious weeds. | Moderate risk for weed spread. Reduced soil cover would be created under this project in the short term. |

Direct Effects

Direct effects from the implementation of any of the action alternatives in the Elk Bugs and Fuels Project would come from translocation of noxious weeds (seeds, roots, stems) into areas that are not infested, or scattering existing occurrences. Equipment that is not weed-free entering the project area or moving from a weed infestation to other areas within the project area can spread noxious weeds. Use of materials for erosion control (such as mulch, straw, and seed mixes) as well as other material such as road gravel can introduce noxious weeds if they are not weed free. National standards and Forest goals have been developed to reduce the risk of introduction of noxious weeds from these activities. These standards are found in the Appendix B: Mitigation.

Indirect Effects

Indirect effects from implementation of the Elk Bugs and Fuels Project generally fall into the category of developing habitat for noxious weeds to become established or spread from current locations. Activities leaving bare mineral soil such as skidding, landing development, road construction/reconstruction, and prescribed/pile burning all leave areas vulnerable to the introduction and spread of noxious weeds. These bare areas are inevitable in projects such as the Elk Bugs and Fuels Project, however this project has been designed to minimize any unnecessary soil disturbance. Forest goals developed to monitor project areas for following seasons to determine if noxious weed infestations

have become established are listed in Appendix C, Mitigation in this document. Other Forest goals have been developed to prevent indirect effects from a project in order to reduce the risk of noxious weed spread including revegetation guidelines, coordination with nearby projects, and to maintain canopy closure where possible.

Cumulative Effects

The effects of noxious weeds can be far ranging and deleterious. Cumulative effects of implementing the action or no action alternatives are discussed in general terms. Extensive infestations of weeds can permanently degrade National Forest System lands based on today's economics and technology. Weed infestations in the project area are moderately extensive. Invasive non-native plants have already taken over or severely impaired millions of acres of western Federal lands, where it is estimated that weeds occur on more than 17 million acres. On National Forest System lands, an estimated 6-7 million acres are currently infested and potentially increasing at a rate of 8 to 12 percent per year.

Invasive plant species are one of the greatest threats to wildlands in the United States (Mullin et al 2000). Weed infestation and spread is one of the greatest negative impacts to maintaining or improving the health of the National Forest System lands in the project area. Plant invaders can completely alter the fire regime, nutrient cycling, hydrology, and energy budgets in a native ecosystem. They can hybridize with native species altering native plant genetics. Maintaining or improving the National Forest System lands in the project area requires the maintenance and improvement of the basic ecosystem elements of soil, water, and vegetation. The stability and ecological function of natural wildlands depend on a diverse community of native plants (Mullin et al 2000). Native vegetation provides resilience against drought and flooding, minimizes erosion, promotes water infiltration and storage, in addition to providing wildlife and recreation values. Areas infested with weeds do not provide resilience to drought, or flooding; minimize erosion; promote water quality and quantity; or provide wildlife and recreational values at the same level as native vegetation.

Weeds arrived in the United States without the insects and diseases that preyed on them, or the plants that evolved in competition with them in their native land. Without insects, diseases, etc. to control these weeds, they increase at a rapid rate and can cause permanent degradation of National Forest System (and other) lands. Research has shown that sites dominated by weeds, have increased rates of soil erosion and runoff causing degradation of habitat for wildlife and native vegetation.

Noxious weeds known from the project area (leafy spurge, spotted knapweed, Canada thistle, hounds tongue, St. Johnswort, musk thistle, wooly mullein, and teasel) could continue to spread in the no action and action alternatives. The spread of these noxious weeds could occur on disturbed sites within and outside of the project area. The amount of soil disturbance and associated loss of soil cover is expected to contribute to the risk of spread of noxious weeds. With complete weed inventory, which was completed for the proposed project areas within the analysis area in 2002, and mitigation measures in place, a reduced risk of increased spread of noxious weeds from the Elk Bugs and Fuels Project is expected.

Social Environment

Recreation

Affected Environment:

The only maintained hiking trail in the Elk Bugs and Fuels project area is the Centennial Trail. This 111-mile trail, is part of the National Hiking Trail System, and runs from Bear Butte State Park (north of Sturgis) to Wind Cave National Park in the southern hills. The trail is primarily used for non-motorized recreation, but a section of the trail, from Pilot Knob trailhead to Dalton Lake trailhead, is open to motorized use. This trail is also heavily used by mountain bikers between Bear Butte and Dalton Lake.

There are no developed recreation sites within the project area, other than the seldom-used Elk Creek trailhead of the Centennial Trail. The nearest Forest Service campground, Dalton Lake, is located three miles south of the project area. With the growth of the Sturgis Motorcycle Rally, a number of campgrounds have been developed along the eastern edge of the project area, all of which are located on private property and outside of the Forest Boundary. These private campgrounds do not have roads leading onto the National Forest but the campers use Forest Lands for a variety of activities (hunting, hiking etc.)

Since the conversion of FH 26 (Sturgis to Nemo road) from a single lane gravel road to a two lane paved road, recreation activity in the project area has increased significantly. The main recreation activities occurring within the project area are driving for pleasure, hiking, mountain biking, ATV use, hunting, rock climbing, horseback riding, and rock hounding.

The area is heavily used for hunting much of the year. Game species in the area are: turkey, grouse, elk, deer and coyote. The eastern side of the project area is very popular for spring turkey hunting. Big game and fall turkey seasons start in late August and continue on into December.

Due to the nature of the geologic setting, only streams on the west half of the project area have sufficient water to support fish populations. Stream fishing for trout is limited to Bear Butte Creek around Galena, Meadow Creek and Elk Creek.

The Deadman Summer Home Group is located in the northeast corner of the project area. This area was established in the 1920s and allowed private individuals to construct a summer cabin on National Forest System Lands and was authorized by a recreational

Special Use permit (new summer home groups are not allowed on National Forests). There are four cabins in this group and they are accessed by road U040036.

There are numerous caves in the project area, two of which are set up for commercial operations. Bethlehem Cave is located on private property and is managed as a commercial stop with cave tours and other events. Wonderland cave is located on National Forest System Lands and is under a Special Use Permit to a private individual to provide cave tours to the general public. Due to the uplifted nature of the sedimentary rock in this area, there are numerous small caves that provide caving experiences to the public.

The area also supports three off road travel events during the summer and fall. These recreation events consist of guided tours using extremely primitive roads and boulder filled dry creek beds for their travel ways. These events are under Special Use Permits issued to two local clubs and one large corporation, which sponsor the three events. Hundreds of 4-wheel drive jeep type vehicles are involved in these events.

The area also has two Outfitter Guide Special Use Permits, one for hunting and the other for guided horseback trail riding. These permits are issued to private individuals.

In the very northeast portion of the project area, along Two-Bit Creek and Boulder Creek, there are numerous mining claims used for gold panning activities by various gold panning clubs and individuals.

Environmental Consequences:

Direct and Indirect Effects on Non-Motorized Recreation

If mitigation measures are implemented as described, there would be no effects from logging, thinning or road building along the Centennial trail from activities proposed in any of the action alternatives. Other forms of non-motorized recreation should not be affected by the proposed activities except for the closing of some unimproved roads that are used by hikers and mountain bikers.

Direct and Indirect Effects on Motorized Recreation

Alternative 1 does not decommission any existing roads so there would be no impacts to motorized recreation. Alternative 2 would decommission 60.7 miles of undeveloped roads (non-system roads) within the project area. Alternative 3 would decommission 62.0 miles of non-system roads. Alternative 4 would decommission 55.9 miles of non-system roads. The majority of these roads are short spurs that come off of existing roads

and may have functioned as skid trails in past timber sales. Most are not through roads and have little effect on recreation. Existing non-system roads used for the off road travel events under special use permits would not be closed and would be available for public use.

Cumulative Effects

The fuel breaks constructed under legislative direction have impacted the Centennial trail, with additional impacts possible from thinning activities in the Alkali and Northwind timber sales. Mountain pine beetle infestations are apparent in numerous sections of the trail and need treatments. Mitigation measure described in this analysis will be implemented for the Alkali and Northwind sales, in order to protect the trail as much as possible, with trail corridors retaining 60 to 80 basal area after thinning. Impacts from thinning along the trail will be kept to a minimum.

Travel along roads 139 and 169 have been heavily impacted by the construction of a 200-foot fuel break along each side of the road. This activity was a result of legislative action and was completed in early 2003. The fuel breaks have caused openings in the timber, providing some vistas over looking Beaver Park and other portions of the Forest and the Eastern Plains. The portion of Centennial Trail that was on FDR 139 will be moved to the edge of the fuel break.

Scenery

Affected Environment:

Introduction

Scenery, as well as other natural resources, must be cared for and managed for future generations. Visual resources vary by location and existing natural features including vegetation, water features, landform and geology, and human-made elements. All activities forest visitors experience are performed in a scenic environment defined by the arrangement of the natural character of the landscape along with components of the built environment.

Landscape Character Description

“The Black Hills are a maturely dissected domed mountain range surrounded by the Missouri Plateau. According to Physiography of the Western United States, the Black Hills comprises the Black Hills section of the Great Plains province.” Appendix B-Description of the Analysis Process, BHNH Forest Plan Revision FEIS.

The project area lies within the Laccolith Mountains landscape character type. This area is described as follows.

“Numerous hills or small mountains are the surface expression of intrusive magmas, doming upward the overlying sediments. These intrusions occurred during the uplift of the Black Hills region (64.5-40 million years ago). The Laccolith Mountains range in diameter from less than a mile to as much as 10 miles and actually consist of laccoliths, stocks and sills. Laccoliths occur at Custer Peak and Sundance Mountain, stocks at Bear Butte and Devils Tower, and sills near Galena. Terry Peak is the highest surface expression of these intrusive bodies, reaching 7,071 feet above sea level. Most of the other Laccolith Mountains range from 5,000 to 6,500 feet in elevation. Mass stability problems for this Physiography area are comparable of the granitic region of the Central Crystalline Area.” Appendix B- Description of the Analysis Process, BHNH Forest Plan Revision FEIS.

Most of the Forest has been intensively managed for a long period of time. This manipulated landscape has become the accepted natural appearing landscape to the surrounding communities of the area. The forested area is predominately covered with ponderosa pine, a valuable merchantable timber source. Harvesting the pine over time in this area has led to an extensive network of roads across the Forested landscape. Spruce, aspen other hardwoods and meadows also occur in the landscape. In combination with active management, fire has played a key role, shaping the landscape into a vegetative mosaic.

A limited amount of ranching occurs within the project area. The ranch lands, including some grazing allotments on the Forest, can be described as lands with dispersed meadows intermingled with stands of aspen, some birch and pine overstories. Ranching is part of the cultural heritage of the area, and range improvements are accepted as components of the valued landscape character unit.

The landscape has also been influenced by the development of the historic mining districts. Mining remnants can be found throughout the project area. Mine shafts, flumes, cabins and other relics are scattered about. The area surrounding Lead and Deadwood is thought to have the greatest variety of ores and in larger quantities than any other place in the world.

The Forest serves as a backdrop for the communities within and adjacent to the project area. These include Sturgis, Lead, and Galena. There are also subdivisions of these communities in proximity to the project area, which is a patchwork of Forest system lands and private lands. Some of the private lands are vacant property, while other parcels are used for residential or business purposes.

This area provides several recreation opportunities. In the winter the area serves as a winter playground for snowmobile riders and skiers. During the summer visitors enjoy hiking, camping, horseback riding. During the fall the project area receives heavy use

from hunters. The unique Sturgis Motorcycle Rally draws thousands of tourists and ‘bikers’ who enjoy sightseeing in the Forest.

Land Use Patterns

Most of the Forest has been intensively managed for a long period of time. This manipulated landscape has become the accepted natural appearing landscape to the surrounding communities of the area. The forested area is predominately covered with ponderosa pine. The pine is a valuable merchantable timber source. Harvesting the pine over time in this area has led to an extensive network of roads across the Forested landscape. Spruce, aspen other hardwoods and meadows also occur in the landscape.

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The Forest serves as a backdrop for the communities within or adjacent to the project area. This includes Sturgis, Lead, and Galena. There are also subdivisions of these communities that are in proximity to the project area. The project area is a patchwork of Forest system lands and private lands. Some of the private lands are vacant property, while other parcels are used for residential or business purposes.

Fire has played a key role in the shaping vegetative mosaic of the landscape. This area provides several recreation opportunities. In the winter the area serves as a winter playground for snowmobile riders and skiers. During the summer visitors enjoy hiking, camping, horseback riding. During the fall the project area receives heavy use from hunters. The unique Sturgis Motorcycle Rally draws thousands of tourists and ‘bikers’ that enjoy sight-seeing in the Forest.

Scenery Enhancement Opportunities

There are stands in the project area with heavy pine encroachment. There is an opportunity to remove the pine to restore the hardwood stands. This type of treatment

could be encouraged adjacent to private lands and homes as well as in primary travel corridors.

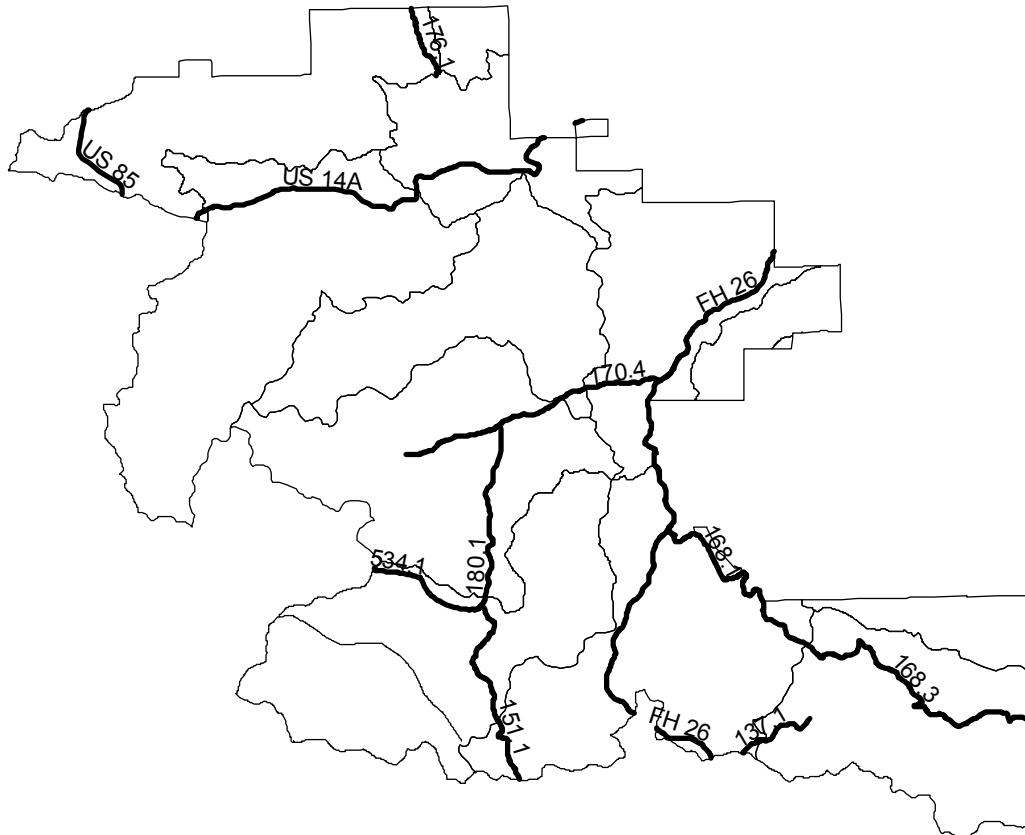
The project area also includes some stands experiencing a pine beetle epidemic. There is an opportunity to reduce the risk of spread of the beetle into other stands within the project area in order to help preserve the current landscape character. Implementing vegetative treatments could do this.

Primary Travel Routes

The project area is most visible from the following primary travel routes:

| | |
|---------------------------|----------------------------|
| State Highway 85 | FDR 137.1 Wonderland Cave |
| FDR 180.1 Erikson | FDR 151.1 Wanhonen |
| FDR 176.1 Crook City | Forest Highway 26 Vanocker |
| FDR 170.4 Galena/Vanocker | FDR 168.1 Crystal Cave |
| FDR 168.3 Crystal Cave | FDR 534.1 Sunny Side |

Figure 3 Primary Travel Ways



Elements of the Scenery Management System

Information regarding various inventories of the Scenery Management System within the project area is illustrated below. Some of the inventories were done at different levels than others. For example some inventories include ratings for private lands, while most do not. This inconsistency has lead to the acreage information for the inventories to be inconsistent. All acreage figures are approximations.

Scenic Attractiveness

Scenic Attractiveness ratings display the relative scenic value of lands within a particular Landscape Character. The three scenic attractiveness classes are:

Class A- Distinctive; Class B- Typical; Class C- Indistinctive.

The landscape elements of landform, vegetation, rocks, cultural features and water features are considered when determining each of these classes.

The following acreages are approximations within the project area

Class A -18, 280 Acres , Class B- 23,708 Acres, Class C- 140,400 Acres

Visual Absorption Capability

Visual Absorption Capability (VAC) analyzes the physical factors of the land and determines their ability to absorb potential landscape alterations. The VAC classes are

1= High ability to absorb change

2= Moderate ability to absorb change

3= Low ability to absorb change

The following acreages are approximations within the project area.

1= High 35,311

2= Moderate 14,090

3= Low 60

Landscape Visibility

Portions of landscapes visible from travelways and use areas are important to Forest visitors for their scenic quality, aesthetic values, and landscape merits. Roads located within and adjacent to the Black Hills where categorized into primary, secondary and primitive concern areas and then rated for the users interest in the views from these areas.

Seen area 1- areas with a high concern for scenery. Seen area 2- areas with moderate concern for scenery, Seen area 3- areas with low concern for scenery. The following acreages are approximations within the project area.

Seen 1- 36,690

Seen 2- 27,246

Seen 3- 3,370

Recreation Opportunity Spectrum

The Recreation Opportunity Spectrum provides a framework for defining classes of outdoor recreation environments, activities and experience opportunities. There are six classes of settings, which provide different activities and experiences. The project area contain three of these classes:

Semi-primitive Non-Motorized (SPNM) settings have subtle modifications to the landscape.

Semi-primitive Motorized (SPM) settings may have obvious modifications to the landscape, but they do not attract attention of visitors in vehicles.

Roaded Natural (RN) settings may have modifications to the landscape that are easily noticed and may dominate the landscape.

The following acreages are approximations within the project area.

SPNM 4,470

SPM 35,240

RN 9,760

Scenic Classes

Scenic classes represent the relative landscape value by combining Distance Zone, Concern Levels, and Scenic Attractiveness inventories.

Generally scenic classes 1-2 have high public value, Classes 3-5 have moderate value.

The following acreages are approximations within the project area.

Classes 1 & 2: 185,688 Acres

Classes 3 & 4: 17,454 Acres

Scenic Integrity

Scenic Integrity is a measure of the degree to which a landscape is visually perceived to be “complete”. The highest scenic integrity ratings are applied to landscapes that have few if any noticeable deviations from the natural landscape. Areas rated as moderate appear slightly altered, and Low ratings appear moderately altered. Landscapes that appear heavily altered are classified as Very Low. The following acreages are approximations within the project area.

High- 15,840

Moderate- 104,390

Low- 28,610

Very Low- 1,080

Environmental Consequences:

Alternative 1 No Action

Direct Effects:

Under this alternative, the stands with a high risk for attack from pine beetles would not be treated. Spread of the pine beetle into currently unaffected stands both within and outside of the project area could occur. These stands would experience a high mortality rate. The landscape could become saturated with dead and dying trees due to the beetle epidemic. The rust colored trees are a sign of unhealthy timber. This would lead to an undesirable recreation setting for Forest visitors by negatively affecting the scenic resources.

The project area has several major roads running through it, and also provides a backdrop for a variety of communities. The scenic quality of these backdrops could be dramatically altered if an epidemic occurred.

Indirect Effects:

Widespread impacts of a beetle infestation would be detrimental to visual quality in the short-term to an extent beyond the analysis area. In the long term, additional species and structural changes in the vegetative canopy may increase visual quality.

Alternative 2 (Modified Proposed Action)

The modified proposed action is designed to move the project area from the existing condition towards the desired future conditions as described in the revised Forest Plan and to meet the purpose and need described in Chapter 1 of this DEIS. The proposed action emphasizes commercial and non-commercial thinning to reduce the current risk of mountain pine beetle infestation and wildfire risk. Fuel treatments to reduce fire hazards near private homes and establish some roadside fuel breaks in cooperation with partner fire-management agencies. Enhancement of hardwoods would occur in some areas. The hardwoods would be maintained or enhanced by removal of encroaching conifers. These activities would be concentrated near private lands and homes. Sanitation cutting would treat stands currently infested with mountain pine beetle. This treatment would reduce mountain pine beetle populations in the local area. In some stands, trees would be selected as a site to place pheromone bait to lure beetles to these trees. The baiting would be done to increase the effectiveness of sanitation cutting.

Creating shaded fuel breaks would reduce the threat and severity of wildfire. Areas in proximity to private lands would be emphasized for treatment. Overstory trees would be thinned 15-20 feet between the crowns and the understory conifers would be removed. Surface fuels would also be removed or intensively treated. The remaining conifers would have the branches pruned up to 10 feet from the ground. The fuel break corridors would average approximately 200 feet on each side of the roadway. Prescribed fire would also be used to reduce fuel loading.

As an initial proposal, the proposed action was designed to act on known public sentiment and preliminary environmental issues. Through broad-based public review, participation, and commentary, it has been refined to better reflect current public priorities and incorporate additional environmental controls.

Alternative 2 proposes to use the following treatment methods:

Table 102 Alternative 2 Treatment Acreages

| Treatment | Acres |
|-----------------------------|--------------|
| Commercial Thinning | 5,794 |
| Non-commercial Thinning | 2,264 |
| Hardwood Restoration | 323 |
| Bait and Sanitation Cutting | 32 |
| Shaded Fuel Breaks | 1,635 |
| Prescribed Burning | 339 |

Transportation Activities

Activities affecting the Transportation system in Alternative 2 include approximately 16.2 miles of new road construction, 26.3 miles of reconstruction and 60.7 miles of decommissioning.

Effects Common to all Action Alternatives

The following treatments would be applied in all action alternatives. The effects will vary by alternative based on the number of acres treated and the location of the treatment.

Commercial and Non-commercial Thinning

Thinning is proposed in both alternatives where the primary product removed is saw-timber. The method is usually thinning from below to remove suppressed, defective, and excess stems. After treatment the trees remaining would have basal area between 40-80 BA.

Direct effects from commercial thinning to visual resource result in increased growth and vigor of the stand

Thinning medium to high stocked stands helps to reduce risk of insect and disease problems. The healthier the forest stands are, the better they appear visually.

Figure 4 Landscape Character after Thinning Treatments

Thinning 60 to 70 BA with slash still on ground



Thinning to 50 BA



Thinned to 80 BA



Thinned to 30 BA



Shaded Fuel-breaks

Fuel-breaks would be used to reduce fire hazards by changing the type, amount, or arrangement of potential fuels. The post treatment basal area would be 50 BA on average, and higher in areas with Goshawk concerns.

These treatments would affect the scenic resources and visitor experience by opening up stands with thick understory vegetation, providing more visual depth into the forest.

Roadside fuel-break treatments would create a park like setting along the road corridors.

Figure 5 Shaded Fuel Breaks

Stand Conditions prior to Mechanical Fuel Reduction Treatment



Mechanical Fuel Reduction Treatment



Prescribed Burning

Prescribed burning would occur as a fuel reduction tool in units 4 and 6 of compartment 82101.

Short-term direct effects from prescribed burning include the presence of black and charred vegetation. This effect is overcome within one year, and would have only a short-term effect on forest visitors.

This fire treatment is used to maintain the open stand characteristics of Ponderosa Pine.

When aspen is present in the stand, burning would enhance the aspen regeneration.

Figure 6 Results of Large Tree Retention with Understory Burn



Hardwood Restoration

Enhancement of hardwoods would occur in some areas. The hardwoods would be maintained or enhanced by removal of encroaching conifers. This treatment would enhance the hardwood component providing more color and textural diversity in the landscape.

Sanitation Cutting and Baiting

These activities would be concentrated near private lands and homes. Sanitation cutting would treat stands currently infested with mountain pine beetle. This treatment would reduce mountain pine beetle populations in the local area. In some stands, trees would be selected as a site to place pheromone bait to lure beetles to these trees. The baiting would increase the effectiveness of sanitation cutting. By removing as much of the beetle brood as possible, in the long-term, these treatments would sustain the landscape character of the area.

Effects of Transportation Activities Common to all Action Alternatives

New Construction and Reconstruction

New road construction is an investment in construction of a road resulting in a new road corridor. Road reconstruction is defined as an activity resulting in improvement or realignment of a road. If the mitigation measures included in this analysis are applied to new road construction and reconstruction, the new roads would meet the adopted scenic integrity objectives of the Forest Plan.

Decommissioning

Decommissioning is defined as activities resulting in the stabilization and restoration of unneeded roads to a more natural state. There are five levels of decommissioning, ranging from road being 1) blocked 2) re-vegetated 3) culverts removed 4) unstable fills removed or 5) roadbed re-contoured. Almost all roads proposed for decommissioning in the action alternatives are non-system “two track” roads developed through public use over time. Decommissioning roads would lead to a more natural landscape character over time as the roadbed revegetates.

Alternative 3: Wildlife Emphasis

This alternative addresses the purpose and need of the project while emphasizing wildlife habitat improvements. Less thinning is proposed than the modified proposed action in order to provide for more structural stage diversity in the project area. These goals would be accomplished by improving existing meadow conditions through removal of encroaching conifers and prescribed burning where practical. Creating open stand conditions on south aspects, and retaining dense stand conditions on north slopes would maintain wildlife habitat. Prescribed fire would be used in open stands on south and west aspects. Heavy thinning in some stands would provide more grass/forb habitat and future large tree habitat.

Table 103 Alternative 3 Treatment Acreages

| Treatment | Acres |
|---|--|
| Commercial Thinning | 4,437 |
| Non-commercial Thinning | 2,219 |
| Hardwood Restoration | 323 |
| Bait and Sanitation Cutting | 0 |
| Shaded Fuel Breaks | 1,635 |
| Prescribed Burning | 874 |
| Meadow Enhancement | 170 * |
| Meadow Enhancement and Prescribed Burning | 59 * |
| Patch Cutting | (Acres to be determined in the field)* |

*These treatments apply only to this alternative

Effects to scenic resources from Meadow Enhancement Treatments

Pine encroaching on natural meadows can be removed to enhance meadow vegetation.

Effects to scenic resources include enhancing the vegetative mosaic by retaining and improving the meadows by removing encroaching pine. This would add spatial variety to the stands and modify the form of the stands and meadows. Prescribed burning may be applied in some of the meadows to improve wildlife forage. The charred vegetation would have a short-term effect on scenic resources.

Patch Cut (PC) Wildlife Habitat Prescription

The intent of this prescription is to create habitat diversity within monocultures of young regenerating pine stands. Treatments include removing all trees in areas of 2-10 acres within given treatment stand, with some stands receiving more than one patch cut. Treatment of residual slash in patch cuts would include one or more of the following applications: lop and scatter, pile and burn, or prescribed burn. Effects to scenic resources from the application of this treatment include the following:

- The continuous forest canopy in the areas this would be applied to would be broken up with the patch cuts, creating more variety in the landscape.
- The majority of stands where the treatment would be applied are old plantations having little structural diversity. The patch cuts would help create more horizontal diversity in the stands, providing additional vegetative variety to the landscape.
- Patch cuts in stands 081505006, 081505067, 81506047 and 815060020 may be visible in the foreground from primary road 168.3.

Transportation Activities

Activities affecting the Transportation system in Alternative 3 include approximately 11.5 miles of new road construction, 23 miles of reconstruction and 62 miles of decommissioning.

Alternative 4: Wildland Urban Interface Emphasis

Alternative 4 incorporates all of the treatments in Alternative 2. Thinning more small diameter pine stands in the wildland urban interface fire management zones would further reduce the spread of fire and decrease the risk of losing habited structures. This alternative proposes to decommission fewer roads than in the modified proposed action in order to maintain those roads for future fire control efforts.

Table 104 Alternative 4 Treatment Acreages

| Treatment | Acres |
|-----------------------------|--------------|
| Commercial Thinning | 6,034 |
| Non-commercial Thinning | 2,347 |
| Hardwood Restoration | 323 |
| Bait and Sanitation Cutting | 32 |
| Shaded Fuel Breaks | 1,635 |
| Prescribed Burning | 874 |

Transportation Activities

Activities affecting the Transportation system in Alternative 4 include approximately 16.2 miles of new road construction, 26.3 miles of reconstruction and 55.9 miles of decommissioning.

Cumulative Effects

The cumulative effects analysis area for this resource is the project area, including both National Forest System lands and those under other ownership.

Past management activities have created a mosaic of forested areas interspersed with meadows and some pockets of hardwoods and spruce providing diversity in the landscape.

Since there are no regulations for scenic resource management on private lands, the effects of ongoing private development adjacent to Forest lands can sometimes have negative effects on scenic resources of the continuous landscape. When activities on private land are designed to limit impacts to scenic resources, the differences between private lands and Forest lands are less noticeable.

Past, Present and Reasonably Foreseeable Future Actions

Boomer Timber Sale EA 2000

The acres treated are estimated at 600-700 acres. The treatments included shelterwood prep cuts, seed cuts and overstory removal. Commercial thinning, POL thinning and group selection treatments were also done. Some areas received special cuts, removing the pine to enhance hardwood stands. This project included Boomer Gulch, Strawberry Creek, and Bear Butte Creek, which are also found within the Mineral project area.

Grizzly Gulch Fire, Aug 2002

This wildfire affected approximately 12,000 acres on Bureau of Land Management (BLM), FS, and private lands. Approximately 1,980 acres affected BLM in Exemption Area. Some acres had salvage/hazard salvage on BLM.

Grizzly Gulch Fire-Salvage and Hazard Tree Removal- 2002-ongoing

This is a BLM Project to remove dead trees killed in the 2002 Grizzly Gulch Fire. This is occurring on BLM lands adjacent to main road up Spruce Gulch to top of ridge, estimated 5 miles, and harvesting dead trees within reach of the road or within tractor slope. Acres salvaged are estimated at 300-600 acres.

Reasonably Foreseeable Activities

Minerals Timber Sale EA—2003

Both the Mineral project and the Elk Bugs and Fuels project would impact Bear Butte Creek and its tributaries. Planned activities in proximity to Highway 385 for this project coincide with past activities of the Boomer Timber Sale.

Legislated Activities

Legislated activities within the project area include non-commercial treatments in the Forbes Gulch area and fuel breaks along the boundaries inside of Beaver Park. Approximately 3,372 acres of activities would occur outside of the project boundary.

Legislated Activities outside of the Project Area

The legislated activities directly south of the project area are visible from primary travel routes FH 26 and FDR 151.

- The majority of activities outside of the project area would occur in Moderate and Low scenic integrity objectives.
- Few of the activities occur in scenic class 3 (moderate concern for scenery), with the majority falling into scenic class 2 (high concern for scenery).
- These activities occur in all of the visibility levels.
- Almost all of the activities occur in the High visual absorption capability class, which can withstand more changes to the landscape than the other classes.
- Almost all of the activities occur in the semi-primitive motorized ROS class.

Effects from the Cumulative Activities

The Grizzly Gulch Fire has left patches of burned timber in the landscape across the Forest starting east near Bear Den Mountain, continuing west to the outskirts of Lead and Deadwood. Some of the standing dead trees are being removed by salvage projects; however there would be remnants of burned trees in this area over the long-term.

A concentration of timber harvesting activities would occur between Strawberry Picnic Area on Highway 385 and FDR 534. This would include the past timber treatments from the Boomer Timber Sale and the proposed activities from the Minerals project. If the mitigation measures identified to reduce impacts to scenic resources are implemented for both projects, the cumulative impacts to scenery in this area would meet the Forest Plan. However, if the mitigations are not adhered to the adopted scenic integrity objective of High may not be met.

The combined effects from the cumulative impacts with implementation of any action alternative would not adversely affect scenic resources or the recreation opportunity spectrum.

Summary of Effects

Scenic Classes

Scenic Attractiveness and Landscape Visibility are components of Scenic Classes. Therefore, the description of scenic classes addresses these scenery management components. Scenic classes 1-2 are landscapes that have been rated as areas of high public concern for scenery. Alternative 4 treats the most amount of areas of scenic classes 1-2 with 6,056 acres. Alternative 2 treats 5,520 acres followed by Alternative 3 treating 5,514 acres. The legislated activities add an additional 2,210 to any alternative. Scenic classes 3-5 are landscapes that have been rated as areas of moderate public concern for scenery. Alternative 4 treats 4,700 acres, Alternative 3 treats 3,235 acres and Alternative 2 treats 2,980 acres.

Scenic Integrity Objectives (SIO)

Areas with a High SIO are naturally appearing landscapes. The amount of acres proposed for treatment in the High SIO differs by 150 acres across alternatives. Alternative 4 treats the most with 2,150 acres, followed by Alternative 3 with 2,020 acres, and Alternative 2 proposing 2,000 acres of treatment. An additional 630 acres will be treated under the legislated activities. The activities proposed in High SIO will likely change these areas to a moderate SIO.

Areas with a Moderate SIO appear slightly altered to the Forest visitor. The amount of acres proposed for treatment in the Moderate SIO are greatest in Alternative 4, followed by Alternative 3 and 2 respectively. Implementation of these proposed activities will likely result in retaining the Moderate SIO.

Areas of Low SIO appear moderately altered. The majority of proposed activities occur in Alternative 2, followed by 4 and 3 respectively. The proposed activities would not change the SIO level.

Landscapes that appear heavily altered are classified as Very Low. Alternative 2 proposes to treat 440 acres in this SIO. The other alternatives would treat one acre of Very Low SIO. The proposed activities would not change the SIO level.

Visual Absorption Capability

Visual Absorption Capability (VAC) is the ability of the landscape to camouflage changes based on the natural landscape character. High VAC areas can withstand the most changes and still appear natural, while in areas of Low VAC, changes in the landscape will be apparent to Forest visitors.

Only 12 acres of treatments are proposed in Alternatives 2 and 4, and none in 3. Alternative 4 proposes to treat 3,930 acres of Moderate VAC, Alternative 2 proposes 3,780 and Alternative 3 treats 3,780 acres. Activities proposed in High VAC cover 7,290 acres in Alternative 4, 7,040 acres in Alternative 3, and 6,580 acres in Alternative 2.

Recreation Opportunity Setting (ROS)

Semi-primitive Non-Motorized (SPNM) settings have subtle modifications to the landscape. Semi-primitive Motorized (SPM) settings may have obvious modifications to the landscape, but they do not attract attention of visitors in vehicles. Roaded Natural (RN) settings may have modifications to the landscape that are easily noticed and may dominate the landscape.

Proposed activities in SPNM are greatest in Alternative 3 treating 850 acres, followed by Alternative 4 proposing 762 acres and Alternative 2 treating 730 acres. Approximately 1.27 miles of new road construction will be decommissioned upon completion of the units accessed by those roads (as shown in Appendix B, mitigation) in alternatives 2 & 4, and approximately .6 miles in alternative 3. This mitigation will maintain the SPNM ROS class that currently exists.

The majority of proposed activities occur in the SPM setting. Alternative 4 treats 8,280 acres, alternative 2 treats 7,530 acres, followed by Alternative 3 treating 7,470 acres. The proximity of new roads to the SPM areas may convert the SPM areas to roaded natural ROS.

The proposed activities in the roaded natural class include Alternative 3 treating 2,280 acres, followed by Alternative 4 treating 2,190 and Alternative 2 treating 2,120 acres. These activities would maintain the ROS class.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

No irreversible or irretrievable commitments of scenic resources would occur with implementation of any action alternative.

Heritage Resources

Affected Environment:

Introduction

BHNF analyzed approximately 32, 236 acres of land administered by the Black Hills National Forest in the Elk Bug and Fuels Analysis Area under Alternatives 1, 2, 3, and 4. This analysis was being prepared for the purpose of reducing the potential risk of mountain pine beetle infestation, improve long-term forest growth and yield, enhance forest diversity, benefit wildlife, and reduce fire hazards.

Of this total, 32, 236 acres have been previously field inventoried with appropriate Level III Heritage Resource coverage. A total of 18,663 acres were inventoried by professional archaeological crews from Red Feather Archeology for this analysis area during September through November 2002 (BHNF Project No. R2003020300029), (Redmond 2003). The additional 13, 573 acres were covered with adequate heritage resource inventories by previous projects conducted for BHNF Analysis Areas, Timber Sales, Prescribed Burns, and projects for range during the late 1980's, 1990's, and 2000 - 2003.

A final Level I files review of Black Hills National Forest records indicates there are 94 cultural resources properties that have been evaluated as “eligible” or “potentially eligible” for nomination to the National Register of Historic Places (NRHP) within the Elk Bugs and Fuels Analysis Area perimeter. An additional 194 properties evaluated as “not eligible” for nomination to the NRHP, are also located inside the Elk Bugs and Fuels Analysis Area perimeter. Of this group, 128 Native American sites date to the prehistoric period, 151 sites are historic in age, 8 sites contain both historic and prehistoric components, and 1 site is an unaffiliated rock shelter.

Some areas surveyed may not be selected for treatment, however, no treatments will occur outside of surveyed areas. Should additional treatments be planned within the Elk/Bug Planning Unit, which do not fall within areas previously surveyed, heritage inventory and reporting will precede project implementation.

Mandatory Legislation

The National Historic Preservation Act of 1966, as amended, provides specific guidance to federal agencies that must consider potential effects to heritage resources as part of the agencies' management activities. These guidelines or protocols are found in Section 106 of 36 CFR 800. Federal agency heritage programs are also mandated by policies and standards set forth in the National Environmental Policy Act of 1969; Executive Order 11593 of 1971; Archaeological Resource Protection Act of 1979; the American Indian

Religious Freedom Act of 1978; Native American Graves Protection and Repatriation Act of 1990; and Executive Order 13175 of November 2000.

Resource Protection Measures

The Black Hills National Forest (BHNF) manages and protects heritage resources on public land for the purpose of public interpretation, cultural importance to Native American Indians or other cultural groups, and for scientific research. Under Section 106 of the National Historic Preservation Act (NHPA), heritage properties are evaluated for their significance of “eligibility” for nomination to the National Register of Historic Places. Potential effects to sites evaluated as eligible, potentially eligible, and Traditional Cultural Properties must be considered. Protection or mitigation treatments are used to avoid or reduce adverse affects.

A standard measure for the protection of heritage resources is intensive field inventory and site identification prior to the implementation of land management projects. Mitigation or protection measures such as site avoidance, capping or plating site surfaces, and altering adverse effects, are possible in consultation with the State Historic Preservation Office, interested Native American Tribes, and other applicable interested parties. Effects to sites can also be reduced or minimized through archaeological recordation, structure recordation, interpretation, increased monitoring, and restrictive covenants.

Environmental Consequences:

Direct Effects to Heritage Resources from Timber Harvest

Timber management will result in various degrees of soil disturbance. Timber harvesting, skid trails, temporary road use, landings, “yarding” of equipment, and piling and disposal of slash piles can adversely affect heritage resources. In comparing the alternatives, Alternative 2 would disturb the greatest number of acres, followed by Alternatives 4 and Alternative 3. Alternative 1 would result in no ground disturbance. As the amount of potential ground disturbance increases the potential for disturbance and adverse effect to heritage resources also increases.

Under Alternatives 2, 3, and 4, disturbance to heritage resources would be minimized through identification and avoidance or mitigation measures. The Forest would be in compliance with Section 106 of the National Historic Preservation Act under each alternative if appropriate avoidance or mitigation measures can be implemented.

Direct Effects to Heritage Resources from Fuel Reduction

Fire management treatments will result in various degrees of soil disturbance. Timber and underbrush removal, mulching, skid trails, temporary road use, landings, “yarding” of equipment, and piling and disposal of slash piles can adversely affect heritage resources. Additional affects to heritage resources occur with low, moderate and high

intensity burn activities. This includes the construction of both hand and mechanical fire lines and breaks. In comparing the alternatives, Alternative 3 would disturb the greatest number of acres, followed by Alternatives 4 and Alternative 2. Alternative 1 would result in no ground disturbance. As the amount of potential ground disturbance increases the potential for disturbance and adverse effect to heritage resources also increases.

Under Alternatives 2, 3 and 4, disturbance to heritage resources would be minimized through identification and avoidance or mitigation measures. The Forest would be in compliance with Section 106 of the National Historic Preservation Act under each alternative if appropriate avoidance or mitigation measures can be implemented.

Direct Effects to Heritage Resources from Roads

Heritage resources can be adversely affected by road construction and reconstruction activities. Adverse effects also occur under certain conditions through use of temporary roads, road maintenance, closures, and road decommissioning activities. Effects to heritage resources are of particular concern where two-track roads are subject to maintenance and use as temporary roads. In most cases mitigation measures which use barrier cloth and additional material fill can reduce damage to heritage resources.

In a review of the Alternatives considered, Alternative 2 will result in the greatest number of miles of road and hence have the greatest potential to affect heritage resources, followed by Alternatives 4 and 3. Alternative 1 will result in the lowest potential to effect heritage resources.

Alternative 2, Alternative 3, and Alternative 4 contain areas planned for road construction, road reconstruction and road decommissioning activities, which have the potential to adversely affect significant historic properties. Specific mitigations were designed and addressed for these proposed road areas in the Mitigation Section of this report. The Forest would be in compliance with Section 106 of the National Historic Preservation Act under each alternative if the appropriate mitigation measures can be implemented.

Indirect Effects to Heritage Resources

Indirect effects from road construction and reconstruction include potential erosion in areas of exposed road surfaces. Additional measures include vehicular access to the historic properties, which could promote future relic hunting, and/or disturbance to contributing features and artifacts by vandals.

Indirect effects from timber harvest and fuels reduction activities are exposure of contributing cultural features and artifacts with the removal of vegetation cover. Exposing these areas could promote access of recreational vehicles and possibly vandalism. Additionally, removal of vegetation and cover within these areas may promote a change in conditions that could lead to additional erosion from natural elements.

Cumulative Effects

This project, in combination with other Forest activities such as timber harvesting, recreation, fuels reduction, and range activities, may have a cumulative effect on heritage resources. Cumulative impacts of these types are difficult to quantify but may be avoided through the implementation of appropriate, site-specific mitigations, when deemed necessary through the consultation process with the State Historic Preservation Office, Tribal Historic Preservation Offices, Native American Tribes, and any other applicable interested parties.

Forseeable Future Actions

Effects on heritage resources from snag removal along fences, range improvements, private land boundaries, power lines, new road access, and survey monuments:

There will be little or no effect to heritage resources by these undertakings provided that eligible and potentially eligible sites, Traditional Cultural Properties, and culturally significant areas are avoided or have mitigations developed and implemented in consultation with the State Historic Preservation Office, Tribal Historic Preservation Office's, Native American Tribes, and any other applicable interested parties.

If the removal of snag trees is conducted by hand felling techniques and not removed by mechanical means from their drop site, there will be no effect to heritage resources.

Conclusions

When an alternative is selected, those sites which are considered eligible, potentially eligible, or unevaluated for the National Register of Historic Place, graves, Traditional Cultural Properties, and culturally sensitive areas, which still fall within areas of potential effect will either be marked on the ground and excluded from all project impacts or impacts to the site will be mitigated depending upon the South Dakota State Historic Preservation Office and Tribal Historic Preservation Office's response to mitigation proposals. No impacts to the sites will occur prior to consultation with the Historic Preservation Offices.

There will be no effect to heritage resources within this analysis area provided that all eligible and potentially eligible properties, Traditional Cultural Properties, and culturally significant areas are avoided or have mitigation measures developed in consultation with the SHPO, THPO's and other interested parties. In addition, the specific mitigations outlined for the 54 known significant cultural resource sites that are located within or adjacent to actions proposed under Alternatives 2, 3, and 4, will be employed prior to project implementation.

All eligible, potentially eligible properties, Traditional Cultural Properties, and culturally significant areas will be avoided or mitigated according to the specific mitigation measures outlined for each site in the Mitigation Section of this report. As a result, it is expected that no potential direct, indirect, or cumulative impacts to cultural resources will occur during implementation of these proposed Alternatives 1, 2, 3, and 4.

Economics

Economic Efficiency Analysis

The main criteria in assessing economic efficiency is Present Net Value (PNV), which is defined as the value of discounted benefits minus discounted costs. A PNV analysis includes all outputs to which monetary values are assigned, including both market and non-market values. In addition, a financial efficiency analysis determines the financial revenues of each alternative. A financial efficiency analysis is the PNV of revenues and costs. The figures generated by economic analysis of land management projects are usually used as means to compare alternatives.

The output of non-market goods such as recreation, for the project area is not expected to change appreciably in any of the alternatives, so the economic efficiency analysis is the same as the financial efficiency analysis for all alternatives. Non-market factors, such as wildfire risk, are difficult to determine and were not included in this analysis.

The economic analysis was generated using Quick Silver, a Forest Service economic analysis program customized for the Rocky Mountain Region. The financial values used are from Black Hills National Forest cost guides based on experienced costs and revenues. Present net value and benefit/cost ratios are displayed in the following table.

Table 105 Present Net Value and Benefit/Cost Ratio by Alternative

| Measure | Alt. 1 | | Alt. 3 | Alt. 4 |
|--------------------|---------------|------------|---------------|---------------|
| Present Net Value | \$0 | -\$725,978 | -\$2,307,134 | -\$1,481,003 |
| Benefit/Cost Ratio | NA | 0.69 | 0.34 | 0.53 |

The economic values generated by the Quick Silver analysis are used as a means to compare alternatives, rather than as an absolute measure. This is done because timber prices tend to fluctuate widely. Actual economic values vary with market conditions and will be determined at the time the timber is sold.

Cumulative Effects

The cumulative effects analysis area for economics includes the counties overlapping the National Forest: Lawrence, Meade, Pennington, Custer, and Fall River Counties in South Dakota; and Crook and Weston Counties in Wyoming.

The Black Hills area economy was dominated by mining, timber harvest, and agriculture for many years. The region's economy is now well diversified (USDA Forest Service, 1996). Major employer Homestake Mine closed at the end of 2001; Homestake's underground mine may be converted into a physics laboratory, predicted to employ many, but this is not yet certain. Another major employer in the northern Black Hills, Pope and Talbot Inc., shut down its Spearfish sawmill for several weeks in 2001 due to low timber prices. The future of some operators in the highly competitive forest products industry is uncertain.

The proposed actions in Alternatives 2, 3, and 4 would contribute to the local economy by producing forest products and employment, and through procurement of services and products associated with project implementation. The level of sawtimber harvest is below that of the other timber sales conducted in the project area over the last 10 to 15 years, due both to new, more restrictive management direction and to the recent level of harvest itself. This project area has perhaps been more intensively managed than many others in recent years, but if timber harvest levels fall substantially across the forest it is reasonable to assume that the forest products industry would be forced to adjust.

Environmental Justice

A specific consideration of equity and fairness in resource decision-making is encompassed in the issue of environmental justice. As in Executive Order 12898 (Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations), all Federal actions will consider potentially disproportionate effects on minority or low-income communities. Consideration of environmental justice issues should be highlighted for decision makers. Potential impacts or changes to low-income or minority communities in the project area due to the Proposed Action should be considered. Where possible, measures should be taken to avoid impact to these communities or mitigate adverse effects.

During the course of this analysis, no alternative resulted in any identifiable effects or issues specific to any minority or low-income population or community. The agency has considered all input from persons or groups regardless of age, race, income status, or other social and economic characteristics.

Civil Rights

No civil rights effects associated with age, race, creed, color, national origin, or sex have been identified.

Short-term Uses and Long-term Productivity

NEPA requires consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

Short-term uses are those expected to occur on the Forest over the next ten years. These uses include, but are not limited to recreation use, grazing, timber harvest, and prescribed burning. Long-term productivity refers to the capability of the land to provide resource outputs for a period of time beyond the next ten years.

The minimum management requirement established by regulation (36 CFR 219.27) provides for the maintenance of long-term productivity of the land. Minimum management requirements prescribed by the forest-wide standards and guidelines assure that long-term productivity of the land will not be impaired by short-term uses.

There is a need to restrict the potential of an insect outbreak in order to manage these stands to minimize volume losses due to insect and disease or other damage agents. Pine beetle epidemics can result in changes that radically alter conditions within a landscape.

Short-term uses include thinning and burning of timber and disturbance of land surface for skid trails. These areas would be returned to vegetation cover and would not reduce long-term productivity.

As provided for by the Forest Plan, minimum management requirements guide implementation of the action alternatives. Adherence to these requirements ensures that long-term productivity of the land is not impaired by short-term uses. Monitoring specified in this EIS and the Forest Plan validates that the management requirements and mitigation are effective in protecting long-term productivity.

Unavoidable Adverse Effects

The application of standards and guidelines, listed mitigation measures and application of the Region 2 Watershed Conservation Practices and South Dakota Best Management Practices, would limit the extent and duration of any potential adverse environmental effects. For detailed disclosure of all effects, including unavoidable adverse effects, see the preceding Environmental Consequences discussions for each resource area. Mitigation and monitoring are in place to minimize impacts to the various resources.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources mean s that nonrenewable resources are consumed or destroyed. Examples include the extinction of a species or the removal of mined ore,

and the destruction of such things as heritage resources by other management activities. None of the proposed actions are expected to result in irreversible commitments of resources.

Irretrievable commitments are those that are lost for a period of time such as the loss of timber productivity in forested areas that are kept clear for use as a power line right-of-way or road. New road construction in alternatives 2, 3, and 4 would represent irretrievable commitments of resources.

Heritage resources will be impacted by the proposed project, but the loss is limited to sites ineligible sites to National Register of Historic Places, or the effect is considered to not affect those characteristics of a site that make it important. The project complies with Section 106 of the National Historic Preservation Act.

Cumulative Effects

Refer to the cumulative effects in the Environmental Consequences section of this document for detailed descriptions of cumulative effects by resource area.

Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs “to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently and integrated with ...other environmental review laws and executive orders.”

The US Fish and Wildlife Service has not been consulted under the Fish and Wildlife Coordination act for water impoundment or diversion because those activities are not proposed.

National Historic Preservation Act requirements have been met for the project and it has been cleared with the State Historic Preservation Office.

U.S. Fish and Wildlife Service and the National Marine Fisheries Service in accordance with the ESA implementing regulations for projects with threatened or endangered species have not been consulted for this project. No threatened or endangered amphibian, fish, or plant species occur within the project area. However, bald eagles (*Haliaeetus leucocephalus*) are the only federally listed (threatened) species occurring in the project area. They are frequent winter migrants within the planning unit; no nesting is known to occur within the Black Hills National Forest.

With relation to national and global petroleum reserves, the energy consumption associated with the individual alternatives, as well as the difference between, is insignificant.